SHRP 2 Renewal Project R11

Strategic Approaches at the Corridor and Network Level to Minimize Disruption from the Renewal Process: WISE User Guide

PREPUBLICATION DRAFT • NOT EDITED

SHRP 2
STRATEGIC HIGHWAY RESEARCH PROGRAM
Accelerating solutions for highway safety, renewal, reliability, and capacity

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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WISE USER GUIDE

Work zone Impact and Strategy Estimator

Version .1A

An Introduction to The WISE Software Package for WISE Version 2.5A

WISE USER GUIDE

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I. Introduction and Overview

What Is WISE?

The WISE software can evaluate the impact of multiple projects that have been incorporated into the Transportation Improvement Program (TIP) and the network. The WISE tool is intended to be a Decision Support System to be utilized by planners and engineers to evaluate the impact of work zones and determine strategies to reduce these impacts. The software has been developed so that the level of effort in conducting analysis is minimal.

WISE is envisioned to be used by agencies to adhere to the "Work Zone Rule." For this reason WISE has been developed based on the definitions and guidelines proposed in the work zone rule.

Key Provisions in the Work Zone Rule Section § 630.1010

Significant Projects.

- *Paragraph (a)* of this section defines a significant project as, "one that, alone or in combination with other concurrent projects nearby is anticipated to cause sustained work zone impacts (as defined in § 630.1004) that are greater than what is considered tolerable based on State policy and/or engineering judgment."
- *Paragraph (b)* requires States to identify upcoming projects that are expected to be significant. It recommends that significant projects be identified as early as possible in the project delivery and development process and in cooperation with the FHWA. It also recommends that the State's work zone policy provisions, the project's characteristics, and the magnitude and extent of the anticipated work zone impacts be considered when determining if a project is significant or not.
  NOTE: The purpose of identifying significant projects is to help develop and implement transportation management plans (TMPs) for projects based on their expected work zone impacts. This is addressed in § 630.1012, "Project-Level Procedures."
- *Paragraph (c)* further qualifies significant project designations by requiring all Interstate system projects within the boundaries of a designated Transportation Management Area (TMA) that occupy a location for more than three days with either intermittent or continuous lane closures to be considered as significant projects.
- *Paragraph (d)* provides an exception clause for the above requirement in paragraph (c). For an Interstate system project or categories of Interstate system projects that are classified as significant through the application of the provisions in paragraph (c), but in the judgment of the State they do not cause sustained work zone impacts, the State may request the FHWA for an exception. Exceptions specifically apply to sections 630.1012(b)(2) and 630.1012(b)(3) of the Rule. Exceptions may be granted by the FHWA based on the State's ability to show that the specific Interstate system project or categories of Interstate system projects do not have sustained work zone impacts.

WISE GUI (Graphical User Interface) is the link between the key WISE tools and metadata within the WISE software package. These key tools consist of the WISE Planning Module, WISE Operation Module, WISE analysis engines, DynusT, and NEXTA. The WISE GUI links these tools using a WorkSpace concept. A single WorkSpace gathers the metadata necessary to define a network, multiple projects, variables, and scheduling data needed to successfully perform an evaluation of a given scenario in the Operation and Planning Modules.

Purpose and Application

The WISE tool has been developed keeping in mind the flow of the program delivery process, and how planners and engineers would need to use this tool. Because continual analysis would be needed in this process, the WISE tool allows multi-resolution modeling (Figure 1), in which data can be passed from macro to meso level models to work in a consistent manner with reasonable ease. The user needs to ensure data compatibility of these models at various levels, and therefore it is anticipated that a multi-resolution approach with ability to choose specific functionality and resolution will provide decision makers with a full range of strategic performance measures as they apply specific work zone strategies and alternatives, to meet specific needs in the project delivery process.

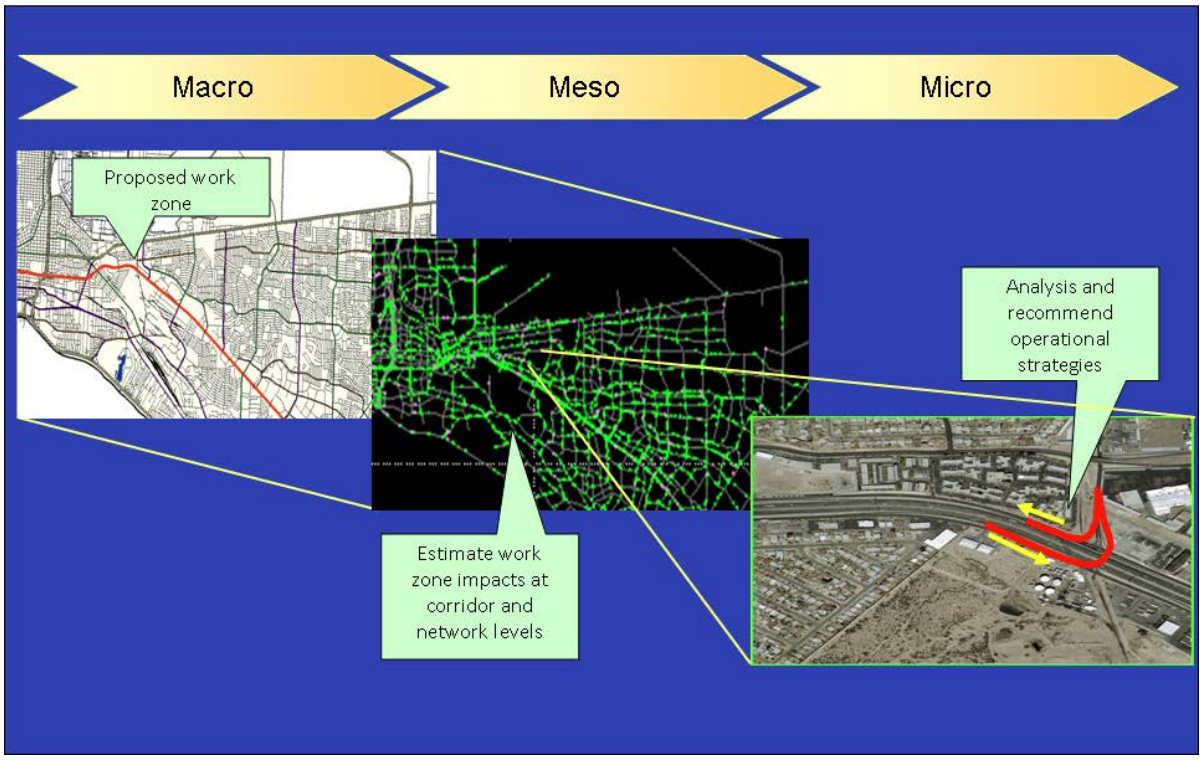


Figure 1: Multi-Resolution Modeling

WISE includes two main elements: the Planning Module and the Operations Module. The Planning Module lets the user evaluate the effectiveness of various travel demand and construction duration strategies for multiple projects through comparisons of two main criteria: construction cost and traveler delay cost (that is converted to monetary cost). Its primary output is a proposed sequencing of projects to minimize overall costs.

The WISE tool can be used to address the following questions:

- What is a good scheduling of renewal projects?
- What strategies are cost-effective with mitigated user delays (congestion) for a program?
- Which traffic management plans work best in given conditions?
- What is the impact on traffic of the present program?

DynusT is the main functionality behind the Operations Module. The concept behind the Operations Module is to dive deeper into the granularity of the time-varying interactions occurring between traffic and the network during a work zone project. What a static model cannot capture — time-dependent congestion and diversion caused by congestion — a simulation model such as DynusT can. DynusT can still use the macroscopic network, yet provide in-depth information of a microscopic simulation model.

The Operations Module requires the sensitivity of a simulation model that responds to congestion so that diversion response is reported in a robust and intuitive manner. The Operations Module attains a more accurate estimation of diversion because of the capacity reduction, i.e., work zone project, based on the network and simulation outcome. In WISE this diversion is reported back to the WISE system, and the user can choose whether to use this estimated diversion rate, i.e., feedback, in the Planning Module. Based on this new diversion rate, the user can model whether this diversion changes the sequencing of projects. The "handshake" feature between the Planning Module and Operation Module enables the power of micro-simulation in a macro-simulation model.

WISE performs traffic diversions in the sequencing algorithm in the planning model to analytically evaluate interdependency of work zone construction projects and the resultant traffic impact and delays network-wide, and recommends a feasible sequence with a rule of minimum traffic delay over the studied seasons and period that the algorithm can find. Although the traffic diversion is an internal analytical analysis module packaged with the sequencing algorithm, WISE has the functionality to execute traffic diversion under three different modes: WISE-supplied, user-supplied, and operation-supplied. The handshake between the Operations Module and Planning Module enables this last option.

Limitations

The model's data structure links very well with DynusT, but needs to be expanded to include other software.

At the Planning stage the model does not consider improvements in capacity and free flow speeds.

Significant effort is needed to calibrate the mesoscopic model.

Risks associated with construction are not considered.

Explicit consideration of materials and workflow of the construction process are not modeled.

II. Getting Started

System Requirements

- Windows-only application:

- x86-compatible processor
- Microsoft® Windows® Server 2008 (32-bit), Windows Vista® (32-bit), Windows 7 (32-bit)
- 512KB of RAM

GUI Specific:

- Operating System: Windows with .Net Framework
- Dynust 3.1
- NOTE: The GUI only has .Net Framework requirements. The only processing requirements should be defined by the WISE Engine or NEXTA/DynusT. The GUI will work with anything running the appropriate Windows .Net Framework

Installation

The CD or online application includes a set-up file named "WISE V2_0_5 Installer.exe." This set-up file is the installer for the entire WISE Software Package, including DynusT and NEXTA. This Installer verifies that the computer in which WISE is being installed meets minimum .NET Framework requirements. If at any time you are prompted in the installer with a .NET Framework error, please visit www.microsoft.com to download the latest .NET Framework installer for your operating system.

Follow the steps below to complete the WISE Software Package Installation.

1. Double-click on the WISE installation file "WISE V2_0_5 Installer.exe"
2. The Installation Wizard will launch (Figure 2); click "Next"

Setup - WISE 2_0_5 2_0_5
Welcome to the WISE 2_0_5 Setup Wizard
This will install WISE 2_0_5 2_0_5 on your computer.
It is recommended that you close all other applications before continuing.
Click Next to continue, or Cancel to exit Setup.
Next >
Cancel

Figure 2 Installation Welcome Screen

3. Verify the directory of the installation (Figure 3), then click “Next”

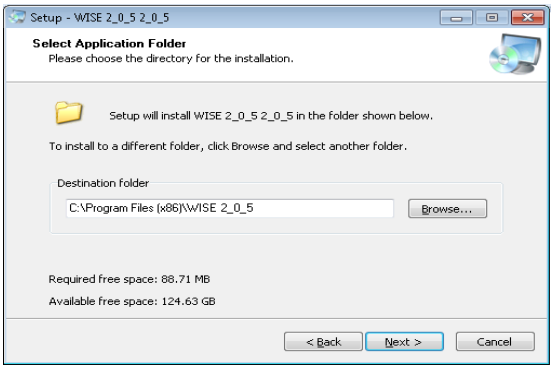

Setup - WISE 2_0_5 2_0_5
Select Application Folder
Please choose the directory for the installation.
Setup will install WISE 2_0_5 2_0_5 in the folder shown below.
To install to a different folder, click Browse and select another folder.
Destination folder
C:\Program Files (x86)\WISE 2_0_5
Browse...
Required free space: 88.71 MB
Available free space: 124.63 GB
< Back
Next >
Cancel

Figure 3: Directory for Installation

4. Verify the shortcut folder options (Figure 4), then click “Next”

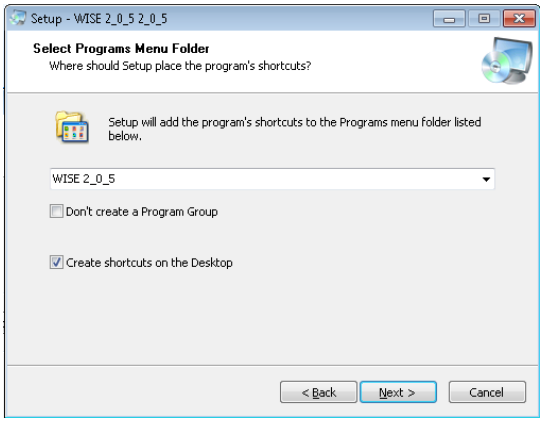

Setup - WISE 2_0_5 2_0_5
Select Programs Menu Folder
Where should Setup place the program's shortcuts?
Setup will add the program's shortcuts to the Programs menu folder listed below.
WISE 2_0_5
Don't create a Program Group
Create shortcuts on the Desktop
< Back
Next >
Cancel

Figure 4: Shortcut Folder Options

5. Verify Installation Setup Options (Figure 5), then click “Install”

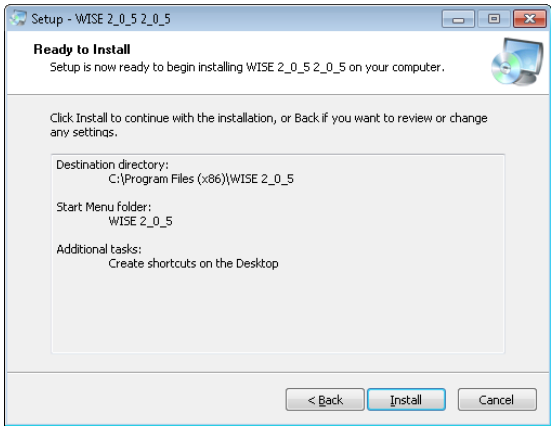

Setup - WISE 2_0_5 2_0_5
Ready to Install
Setup is now ready to begin installing WISE 2_0_5 2_0_5 on your computer.
Click Install to continue with the installation, or Back if you want to review or change any settings.
Destination directory:
C:\Program Files (x86)\WISE 2_0_5
Start Menu folder:
WISE 2_0_5
Additional tasks:
Create shortcuts on the Desktop
< Back
Install
Cancel

Figure 5: Installation Setup

6. After WISE Installation Progress Bar Screen completes, DynusT 3.1 Installation is launch, if administrator to the computer, click “Yes” on “User Account Control” prompt (Figure 6)

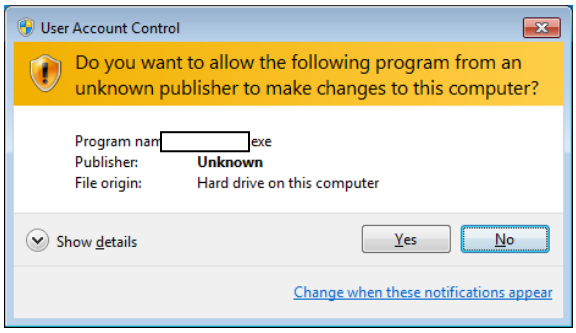

User Account Control
Do you want to allow the following program from an unknown publisher to make changes to this computer?
Program nan exe
Publisher: Unknown
File origin: Hard drive on this computer
Show details
Yes
No
Change when these notifications appear

Figure 6: User Account Control

7. You will see the “Welcome” message from the installation. Click “Next” on the “Welcome” window

8. Enter the serial number: 3979-3716-9135-2536 (Figure 7). Click “Next” after

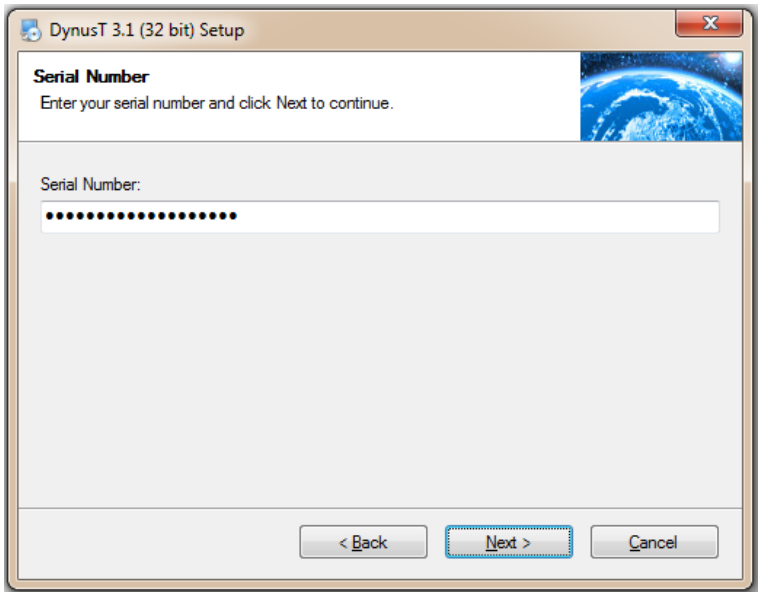


Figure 7: Serial Number

9. Click “I agree to the terms of this license agreement” radial button on the “License Agreement” window (Figure 8)

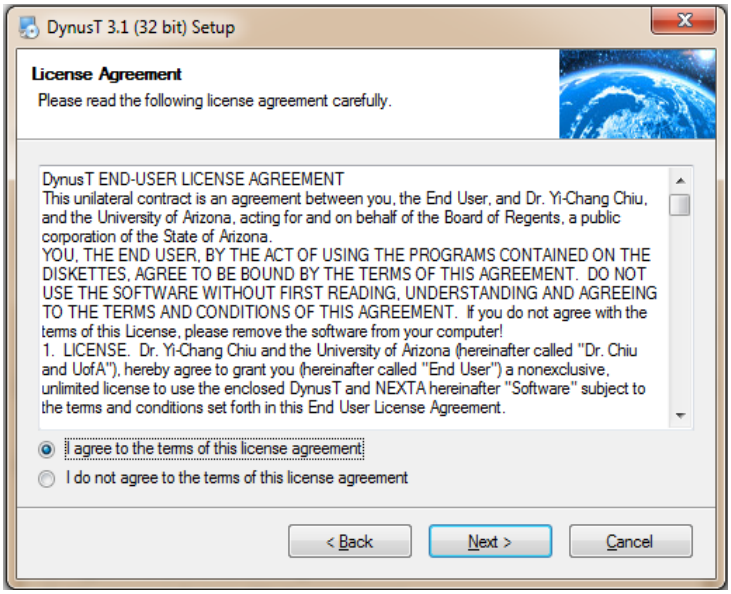

DynusT 3.1 (32 bit) Setup
License Agreement
Please read the following license agreement carefully.
DynusT END-USER LICENSE AGREEMENT
This unilateral contract is an agreement between you, the End User, and Dr. Yi-Chang Chiu, and the University of Arizona, acting for and on behalf of the Board of Regents, a public corporation of the State of Arizona.
YOU, THE END USER, BY THE ACT OF USING THE PROGRAMS CONTAINED ON THE DISKETTES, AGREE TO BE BOUND BY THE TERMS OF THIS AGREEMENT. DO NOT USE THE SOFTWARE WITHOUT FIRST READING, UNDERSTANDING AND AGREEING TO THE TERMS AND CONDITIONS OF THIS AGREEMENT. If you do not agree with the terms of this License, please remove the software from your computer!
1. LICENSE. Dr. Yi-Chang Chiu and the University of Arizona (hereinafter called "Dr. Chiu and UofA"), hereby agree to grant you (hereinafter called "End User") a nonexclusive, unlimited license to use the enclosed DynusT and NEXTA hereinafter "Software" subject to the terms and conditions set forth in this End User License Agreement.
I agree to the terms of this license agreement
I do not agree to the terms of this license agreement
< Back
Next >
Cancel

Figure 8: License Agreement

10. Enter the user name and company name in the “User Information” window (Figure 9), then click “Next”

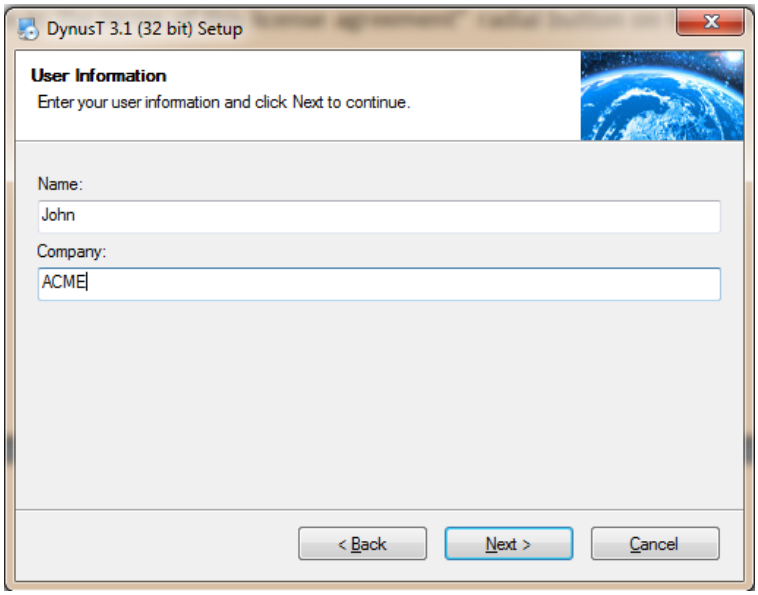


Figure 9: User Information

11. Verify the directory of the installation, then click “Next” on the “Installation Folder” window (Figure 10)

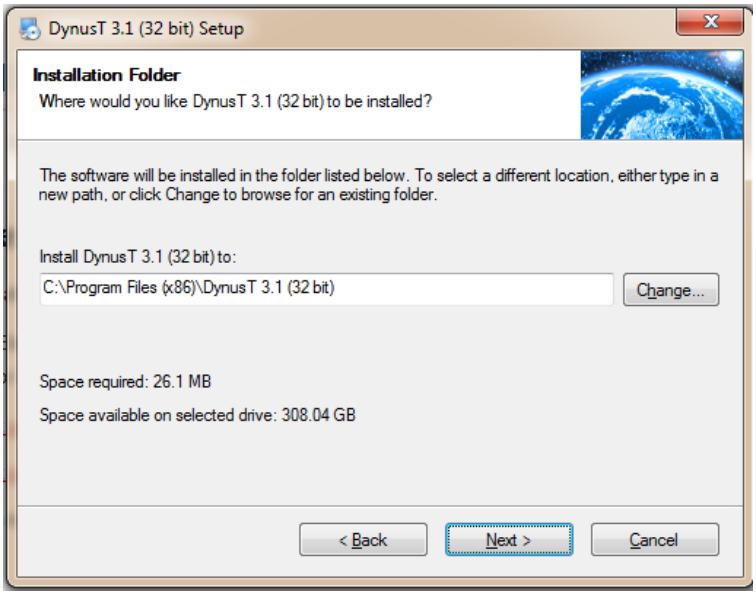

DynusT 3.1 (32 bit) Setup
Installation Folder
Where would you like DynusT 3.1 (32 bit) to be installed?
The software will be installed in the folder listed below. To select a different location, either type in a new path, or click Change to browse for an existing folder.
Install DynusT 3.1 (32 bit) to:
C:\Program Files (x86)\DynusT 3.1 (32 bit)
Change...
Space required: 26.1 MB
Space available on selected drive: 308.04 GB
< Back
Next >
Cancel

Figure 10: Verify Directory

12. Click “Next” on the “Ready To Install” window (Figure 11) to proceed to the actual installation

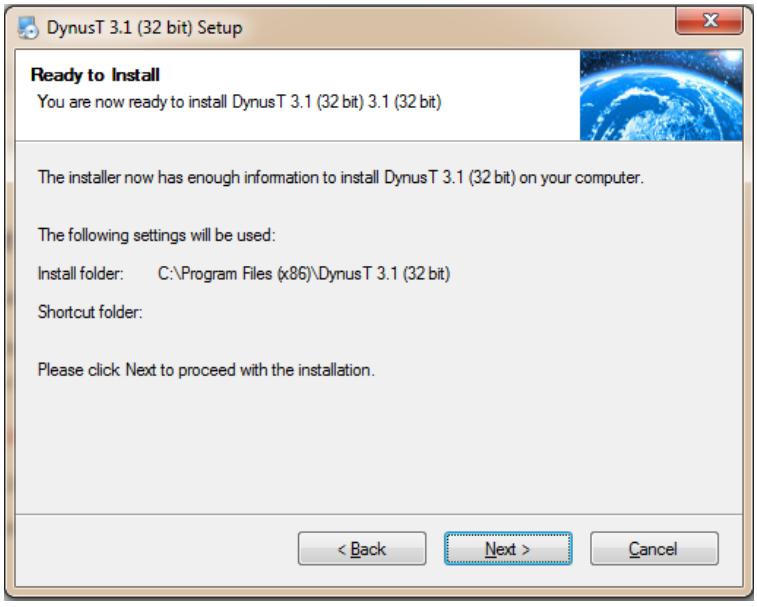

DynusT 3.1 (32 bit) Setup
Ready to Install
You are now ready to install DynusT 3.1 (32 bit) 3.1 (32 bit)
The installer now has enough information to install DynusT 3.1 (32 bit) on your computer.
The following settings will be used:
Install folder: C:\Program Files (x86)\DynusT 3.1 (32 bit)
Shortcut folder:
Please click Next to proceed with the installation.
< Back
Next >
Cancel

Figure 11: Ready to Install

13. The installation will begin running. There will be three windows that will open on-screen simultaneously
    a. The original installation window (Figure 12) will show the progress

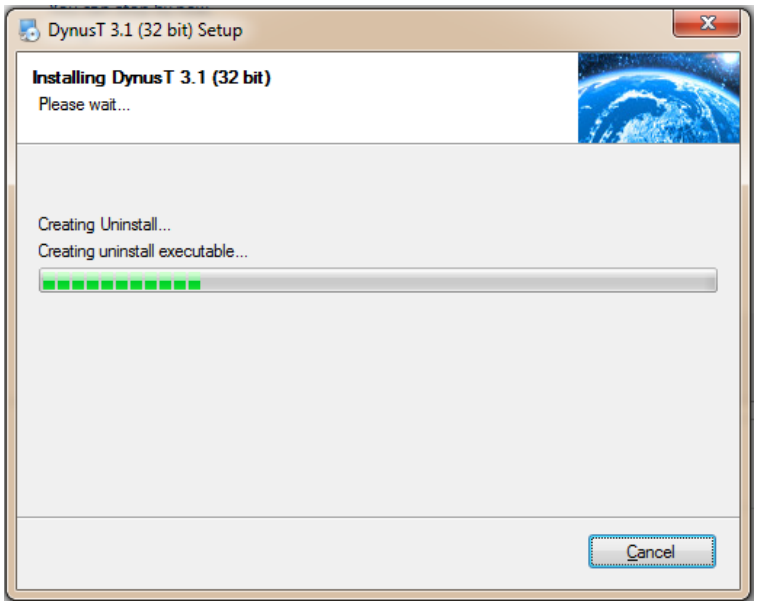
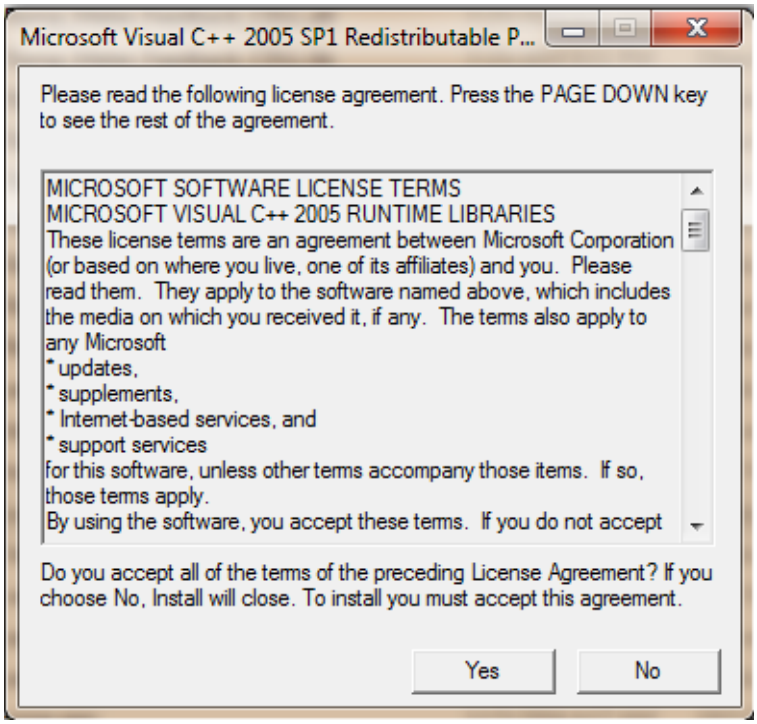


Figure 12: Progress of Installation

    b. The "Microsoft Visual C++ Redistributable Package" window will open (Figure 13). Click "Yes" and the installation of this package will be complete


Microsoft Visual C++ 2005 SP1 Redistributable P...
Please read the following license agreement. Press the PAGE DOWN key to see the rest of the agreement.
MICROSOFT SOFTWARE LICENSE TERMS
MICROSOFT VISUAL C++ 2005 RUNTIME LIBRARIES
These license terms are an agreement between Microsoft Corporation (or based on where you live, one of its affiliates) and you. Please read them. They apply to the software named above, which includes the media on which you received it, if any. The terms also apply to any Microsoft
* updates,
* supplements,
* Internet-based services, and
* support services
for this software, unless other terms accompany those items. If so, those terms apply.
By using the software, you accept these terms. If you do not accept
Do you accept all of the terms of the preceding License Agreement? If you choose No, Install will close. To install you must accept this agreement.
Yes
No

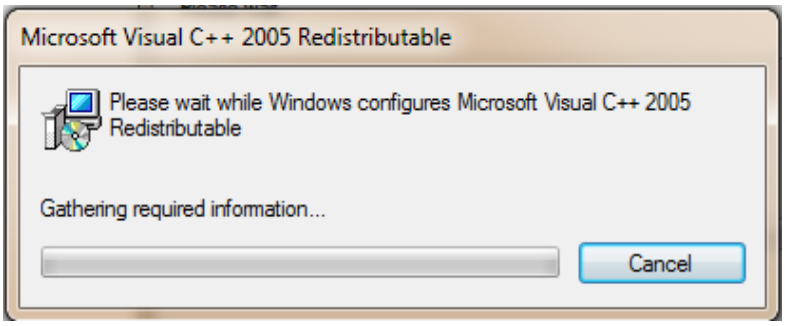

Microsoft Visual C++ 2005 Redistributable
Please wait while Windows configures Microsoft Visual C++ 2005 Redistributable
Gathering required information...
Cancel

Figure 13: Redistributable Package Window

c. The “Setup” window (Figure 14) will also open simultaneously with the “Microsoft Visual C++ Redistributable Package” window
    i. Click “Next”

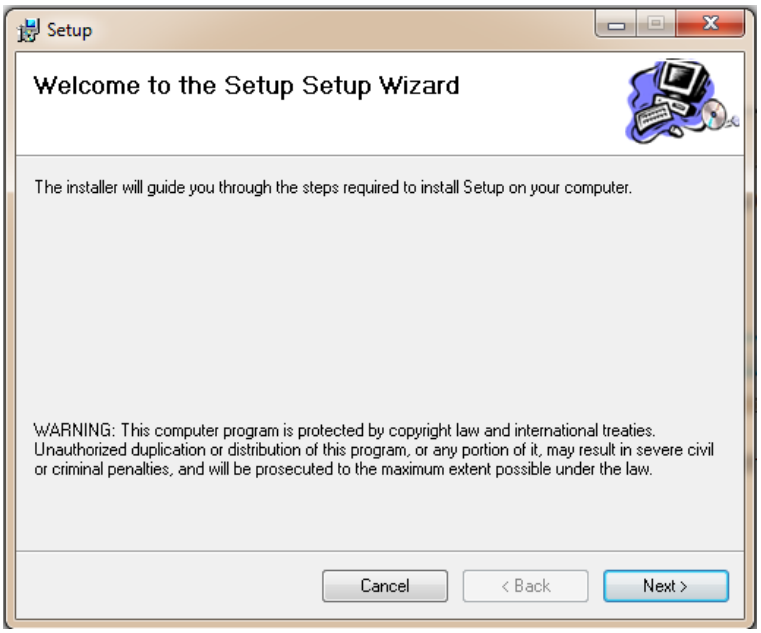

Setup
Welcome to the Setup Setup Wizard
The installer will guide you through the steps required to install Setup on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
< Back
Next >

Figure 14: Setup Window

ii. Verify the location of this installation (Figure 15). Click “Next”

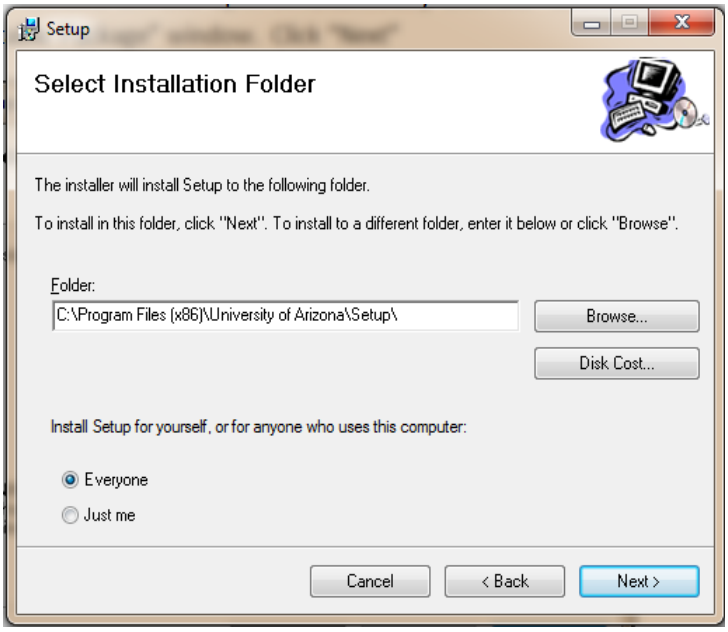

Setup
Select Installation Folder
The installer will install Setup to the following folder.
To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".
Folder:
C:\Program Files (x86)\University of Arizona\Setup\
Browse...
Disk Cost...
Install Setup for yourself, or for anyone who uses this computer:
Everyone
Just me
Cancel
< Back
Next >

Figure 15: Verify Location

iii. If administrator to the computer, click “Yes” on “User Account Control” prompt (Figure 16)

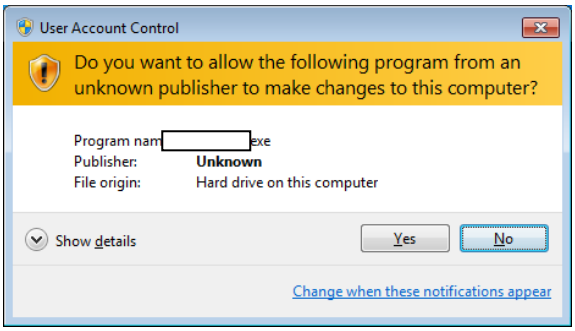


Figure 16: User Account Control, Setup

iv. The “Setup” window will display the installation progress (Figure 17)

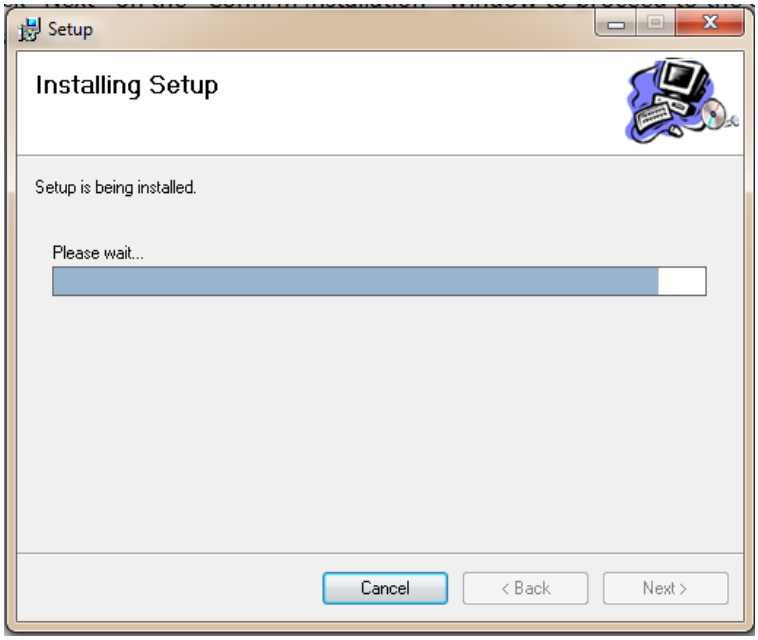


Figure 17: Setup Installation Progress

v. Click “Close” to complete the installation of “Setup” (Figure 18)

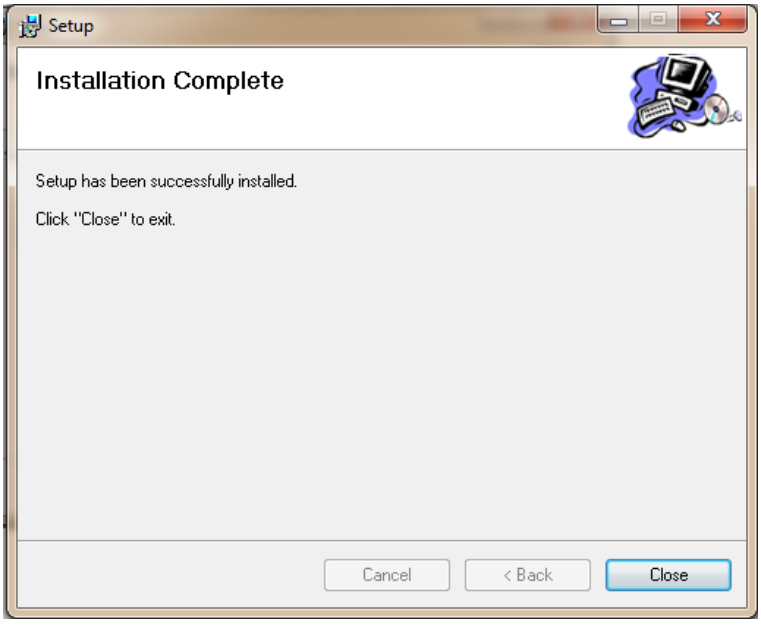


Figure 18: Installation Complete

14. Once DynusT “Setup” installations are complete, click on “Finish” on the original installation window to complete the installation (Figure 19)

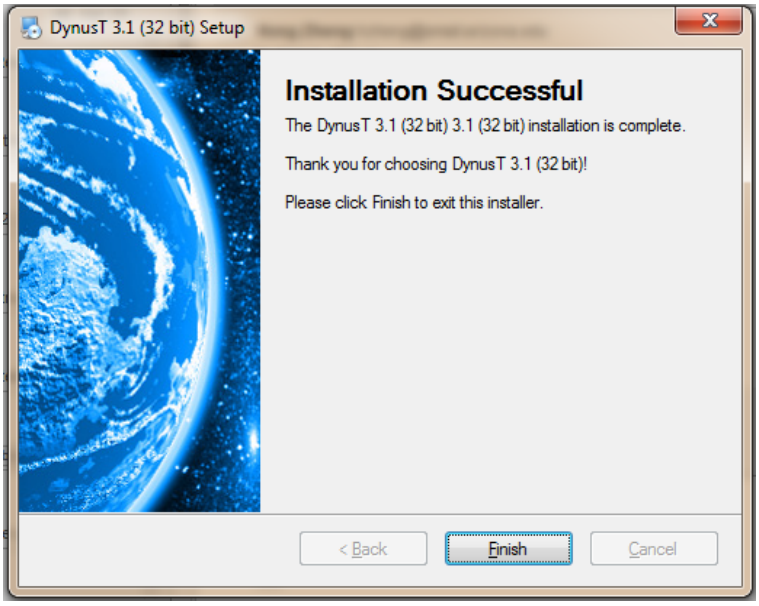

DynusT 3.1 (32 bit) Setup
Installation Successful
The DynusT 3.1 (32 bit) 3.1 (32 bit) installation is complete.
Thank you for choosing DynusT 3.1 (32 bit)!
Please click Finish to exit this installer.
< Back
Finish
Cancel

Figure 19: Finish Installation

15. You will be returned to the WISE Installation completion window, click “Finish” and WISE will be launched (Figure 20)

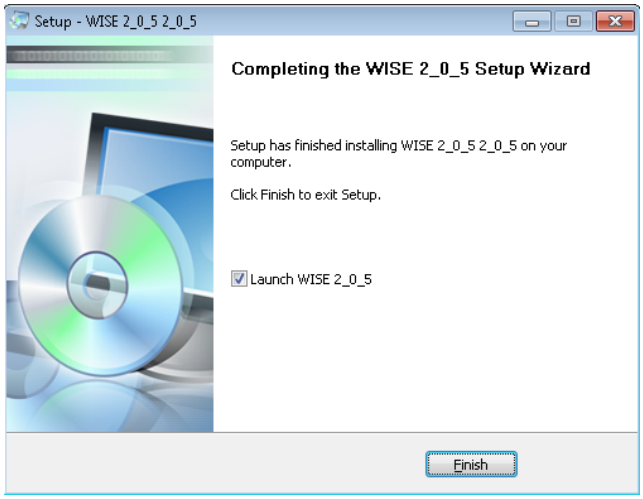

Setup - WISE 2_0_5 2_0_5
Completing the WISE 2_0_5 Setup Wizard
Setup has finished installing WISE 2_0_5 2_0_5 on your computer.
Click Finish to exit Setup.
Launch WISE 2_0_5
Finish

Figure 20: WISE Is Launched

Minimum Data Requirements

- The user has the option of importing a predefined network, creating a new network, or modifying the current network. The network dataset will have to be created in or converted to DynusT format.

It must contain node, link, and zone information. More details can be found in the Planning Section's detailed Network Conversion section (Section V) and the Planning Section (Section IV).

- All Planning Characteristic fields must be populated with valid values for the WISE Analysis Engine to run. The Planning Characteristics consist of the following:
    - The Season Factor for each month of the year (defaults to 1),
    - Start and End time of the entire program (MM/YYYY Format),
    - Value of Time for the program (Dollars per Hour),
    - Demand Number of Hours for Day and Night, and
    - A Program Description.
- The user has the option of Importing an Existing Static Assignment or Importing Day and Night demand and running the WISE OBA (Origin-Based Algorithm for the Traffic Assignment Problem) Evaluator.
- Required project information includes:
    - Earliest start time,
    - Latest completion time,
    - Precedence constraints, if any,
    - Agency project cost,
    - Mapping of each project to links in the network. See "Creating Projects" under the Planning Module (Section IV).
- The Planning Module includes drop down lists of demand-based and duration-based strategies that can be tested. At least one strategy must be selected, along with associated strategy attributes.

GUI Tools

The WISE Software Package is managed via a Graphical User Interface (Figure 21).

The four core topics are WorkSpaces (Section III), Planning Module (Section IV), Operation Module (Section VI), and Planning / Operation Hand-Off (Section VII). These sections provide sufficient information to permit the user to navigate through the WISE Software Package utilizing all of the functions. Section V provides in-depth instructions for importing, converting, and/or creating a network

and importing traffic information.

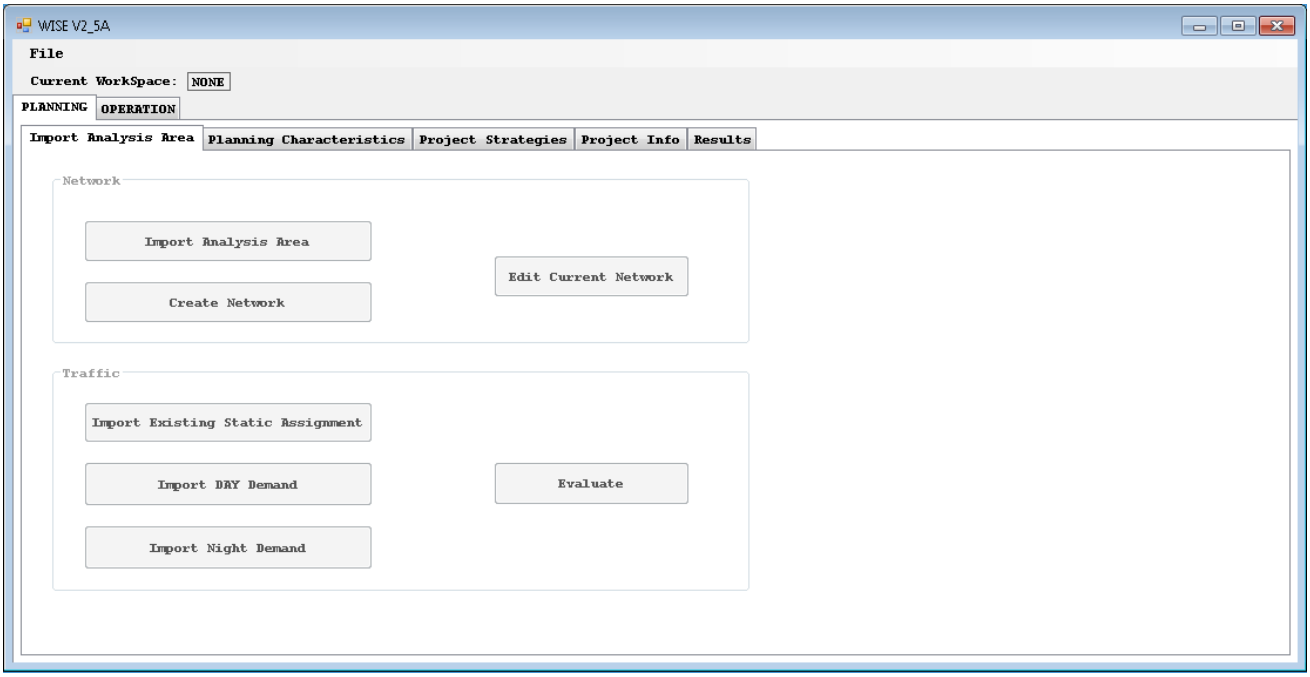


Figure 21: WorkSpace Screen

Create a WorkSpace / Open an Existing WorkSpace

Managing WorkSpaces

All use of the WISE Software Package must be completed within a defined WorkSpace. A WorkSpace is a directory that contains all of the data related to an instance of WISE needed for a complete analysis. When you launch WISE, you must either open an existing WorkSpace or create a new WorkSpace in order to begin using WISE. The WorkSpace that you choose/create will contain all of the data that is utilized in the Planning and Operations Modules. The Current WorkSpace is at all times displayed across the top of the GUI Window next to "Current WorkSpace." In the event that a WorkSpace is not yet selected, the Current WorkSpace will be displayed as "NONE" (Figure 22 and none of the Planning or Operation Functions will be available to the user.

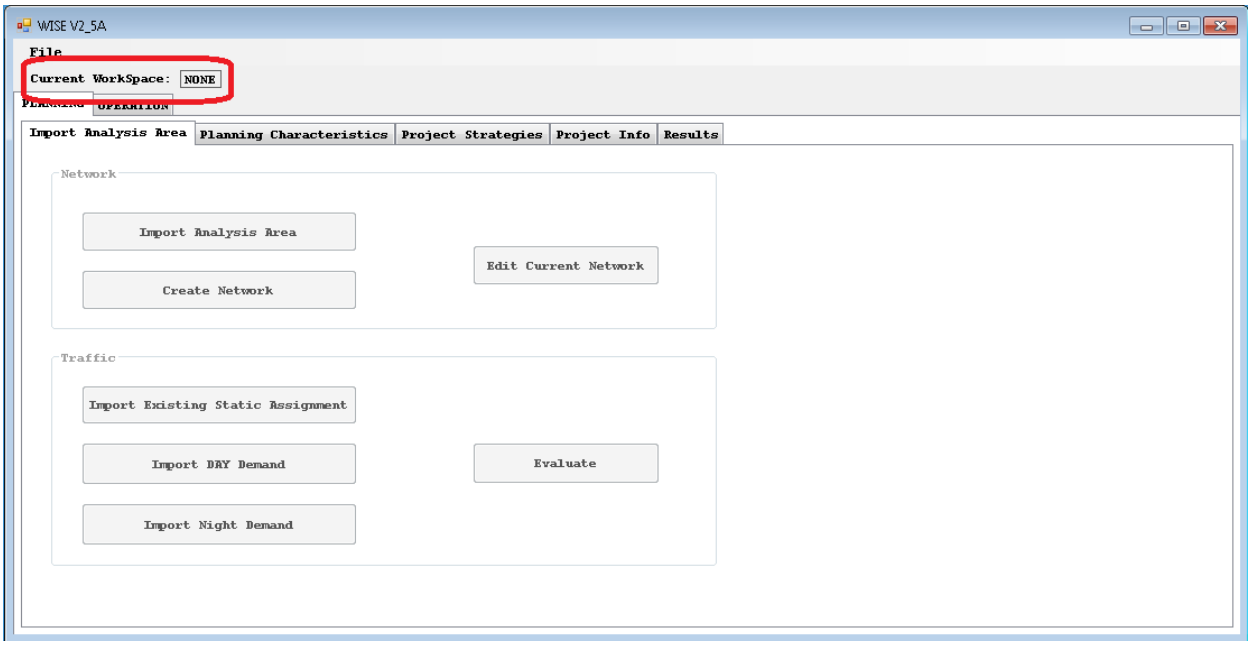


Figure 22: WorkSpace Example

Creating a New WorkSpace

To create a new WorkSpace, select ***File -> Create New WorkSpace*** (Figure 23). A browser window will appear on the screen, which the user must navigate to where the WorkSpace is to be saved and provide a directory name for the WorkSpace. Then Select ***OK***. Once the WorkSpace has been successfully generated, WISE will create a notification saying, "*The Following WorkSpace Has Been Created: <WorkSpace Name>.*"

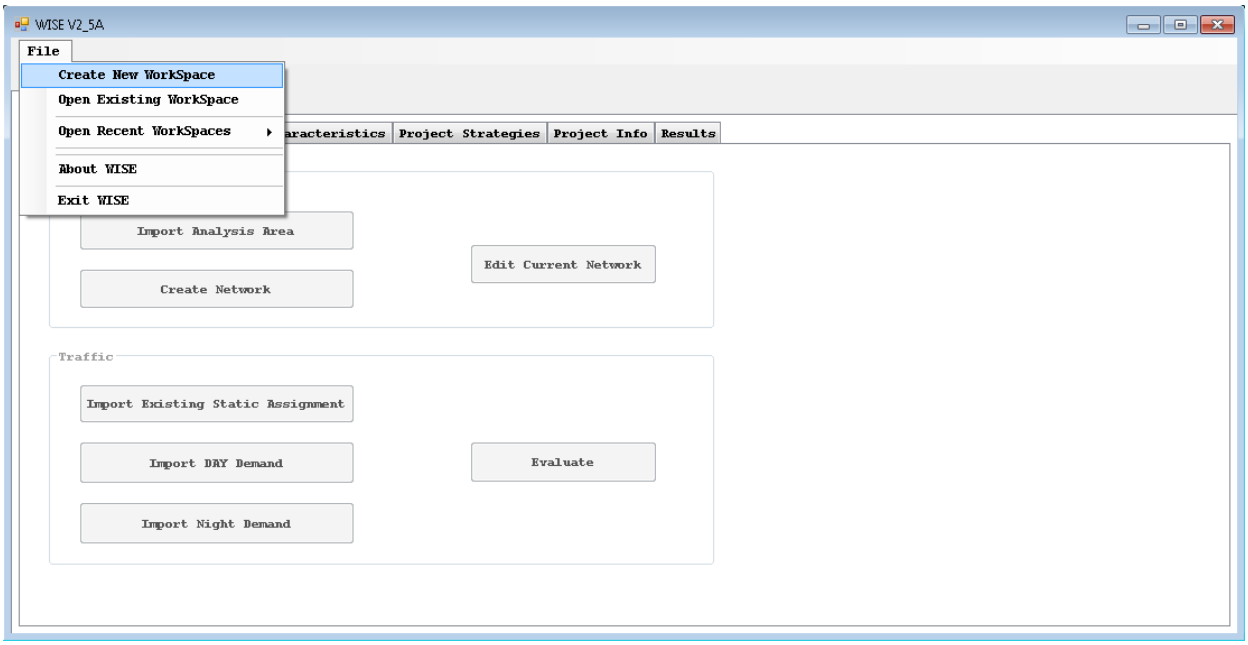


Figure 23: WorkSpace Drop Down Menu

Opening an Existing WorkSpace

To open an existing WorkSpace, select ***File -> Open Existing WorkSpace*** *OR* ***File -> Open Recent WorkSpaces***. Recent WorkSpaces contain the last four WorkSpaces (Figure 24) that were accessed. The ***Open Existing WorkSpace*** function will display a browser window, which the user must navigate to the WorkSpace to be opened; select the WorkSpace and click *OK*. If the selected folder is not a valid WISE WorkSpace, an error will be displayed and no WorkSpace will be opened.

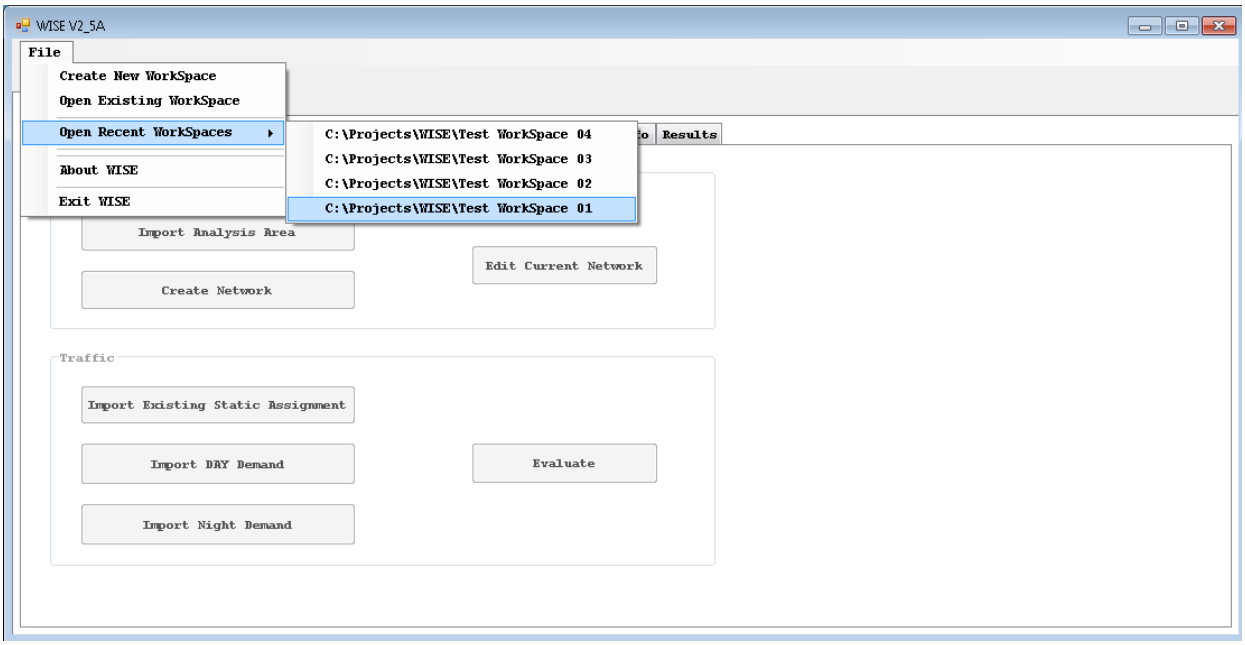


Figure 24: Open Recent WorkSpace Dropdown Menu

Save and Close a WorkSpace

To save the current WorkSpace, select ***File -> Save WorkSpace***. WISE will run an initial validation of the WorkSpace and provide a list of errors, if applicable, and an option to save anyway via *Yes* or *No*. If you select *Yes*, the WorkSpace will be saved containing all of the errors identified and available for you to continue updating or return to at a later time. If you select *No,* you will be returned to the current WorkSpace without losing any data.

To close a WorkSpace, *select* ***File -> Close WorkSpace***. WISE will prompt the user to save the WorkSpace before closing via *Yes* or *No*. If you select *Yes*, WISE will run the same validation as performed during the Save function above and prompt you if you would like to Save with errors if errors are found. If errors are found and you select No, WISE will not close and will return you to the active WorkSpace, allowing you to fix errors or Close without Saving.

WorkSpace Folder Structure and Important Files

WorkSpaces have a specific file structure that WISE relies upon to operate. This file structure consists of a primary WorkSpace folder, which is the main folder you save as your WorkSpace name during creation. All subfolders and data related to a WorkSpace are stored within the primary WorkSpace Folder.

The Primary WorkSpace folder contains up to four documents along with two sub-folders, "Planning" and "Operation." All of the documents and subfolders are created or populated by the WISE GUI. Manual manipulation of these folders or documents is not necessary during typical use of WISE.

The four documents that can be found in the Primary WorkSpace folder are listed below with their origin (either WISE User Interface or Network Import File).

LinkMatrix.csv - WISE
SavedLinkMatrix.csv - WISE
WISE_Version.txt - WISE
WorkZone.date – Network

The two LinkMatrix files are used to store WorkSpace data related to the Network Links and the interface between the Planning and Operation Modules.

The "Planning" sub-folder is the main folder, which will contain all of the Network data, error logs, and files necessary to run NEXTA and DynusT with the associated WISE WorkSpace. The Planning folder should only ever contain one Network File (file with .dws extension). You may notice that some files are duplicated in the "Planning" sub-folder and the Primary WorkSpace folder; this is normal behavior for WISE. The "Planning" sub-folder will also have three subfolders of its own, which contain the WISE Analysis Engines. These folders are "Demand," "Main_schedule," and "OBA." All of the folders are generated at the creation of a new WISE WorkSpace and may take a few moments to be created.

The following documents, which can be found in the "Planning" sub-folder, are listed below with their origin as either WISE or Network Files (* indicates this must be present in all network analysis areas to import a network successfully)

~~~.dws* - Network
DynusT.exe – Network
NEXTA.exe – Network
NEXTA_Config.xml - Network
bg_demand_adjust.dat* - Network
bitmap.dat* - Network
bus.dat* - Network
control.dat* - Network
demand.dat* - Network
demand_HOV.dat* - Network
demand_superzone.dat* - Network
demand_truck.dat* - Network
destination.dat* - Network
~~~

epoch.dat* - Network
GradeLengthPCE.dat* - Network
incident.dat* - Network
leftcap.dat* - Network
linkname.dat* - Network
linkxy.dat* - Network
movement.dat* - Network
network.dat* - Network
node.csv* - Network
node_error.log* - Network
origin.dat* - Network
output_option.dat* - Network
parameter.dat* - Network
pathxyz.bat – WISE
pricing.dat* - Network
Project.html – WISE (Document generated by WISE containing all of the WorkSpaces Project Characteristics)
ramp.dat* - Network
scenario.dat* - Network
sensor.dat* - Network
StopCap2Way.dat* - Network
StopCap4Way.dat* - Network
subarea.dat* - Network
super_space_split.dat* - Network
super_time_split.dat* - Network
superdemand.dat* - Network
superzone.dat* - Network
system.dat* - Network
toll.dat* - Network
TrafficFlowModel.dat* - Network at
version.dat* - Network
vms.dat* - Network
WorkZone.dat* - Network
xy.dat* - Network
YieldCap.dat* - Network
zone.dat* - Network
zone_mapping.dat* - Network

Additional error log files may be generated during WISE normal operation. At the time that an error log is necessary, the WISE User Interface will notify the user where the log file can be found.

I. Planning Module

Importing a Network

All WorkSpaces must contain one valid network, which contains all Projects. All networks must be imported in the NEXTA Format (see Section V for instructions on generating a NEXTA Network). The user has the option of importing a predefined network, creating a new network, or modifying the current network. All of these options are available under ***Planning -> Import Analysis Area - > Network*** (Figure 25).

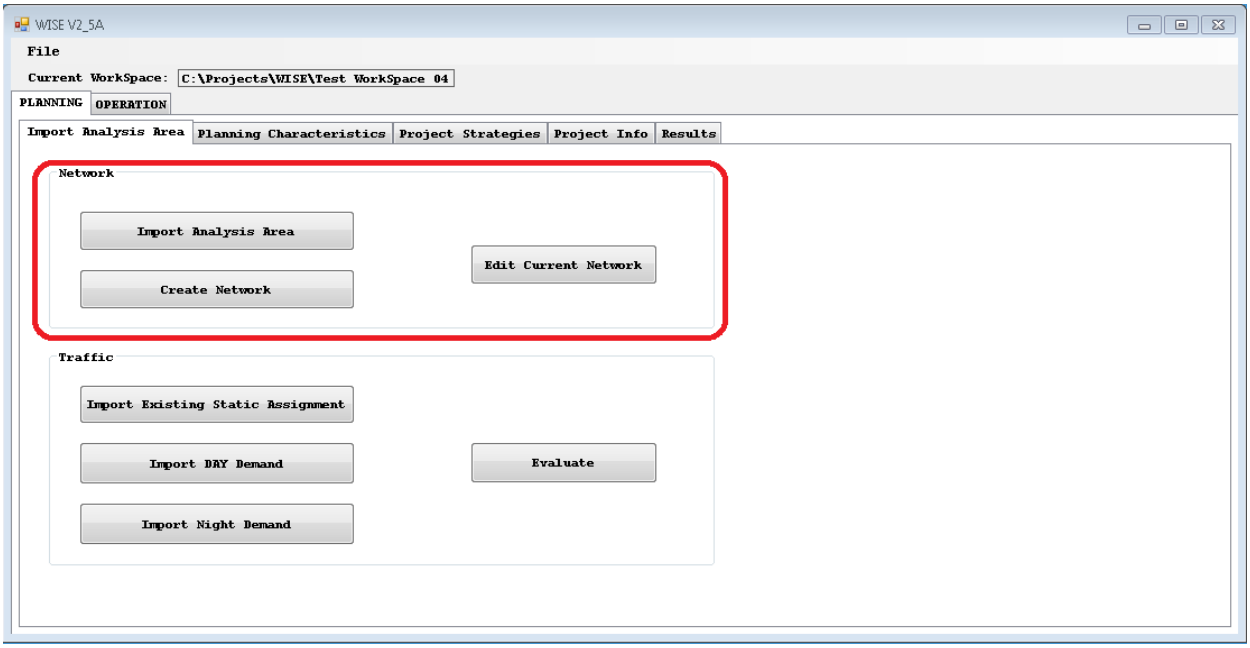


Figure 25: Import Analysis Area Tab: Networks

Importing an Existing Network

To import an existing network, select ***Import Analysis Area***, and a browser window will appear. Navigate to the folder containing the network and select ***OK***. **NOTE:** If you already have a network defined in a WorkSpace, this will ERASE the current Network in its entirety. This **WILL NOT** be reversed if you exit WISE without saving changes. See Section V for instructions on converting an existing network to be usable in WISE.

Creating a New Network

To create a new network, select ***Create Network***, and NEXTA will be launched. See Section V for instructions on creating a NEXTA Network. Once you have created the network, save the network in the Planning Folder of the WorkSpace and close NEXTA. **NOTE:** If you already have a network defined in a WorkSpace, this will ERASE the current network in its entirety. This **WILL NOT** be reversed if you exit WISE without saving changes.

Modifying Current Network

To modify the existing network, select ***Edit Current Network***, and NEXTA will be launched with the current network open for editing. See Section 3.1 for additional NEXTA instructions. Once you have modified the network, save the network and close NEXTA.

Importing Traffic

The user has the option of importing an existing static assignment or importing day and night demand and running the WISE OBA Evaluator. All of these options are available to the user under ***Planning -> Import Analysis Area - > Traffic*** (Figure 26). All of the Import buttons (Import Existing Static Assignment, Import Day Demand, and Import Night Demand) open a browser window, and the user must navigate to, highlight, and select OK for the file that they chose to import. The Evaluate button will run the OBA analysis as described above. See Section V for greater detail on importing traffic data.

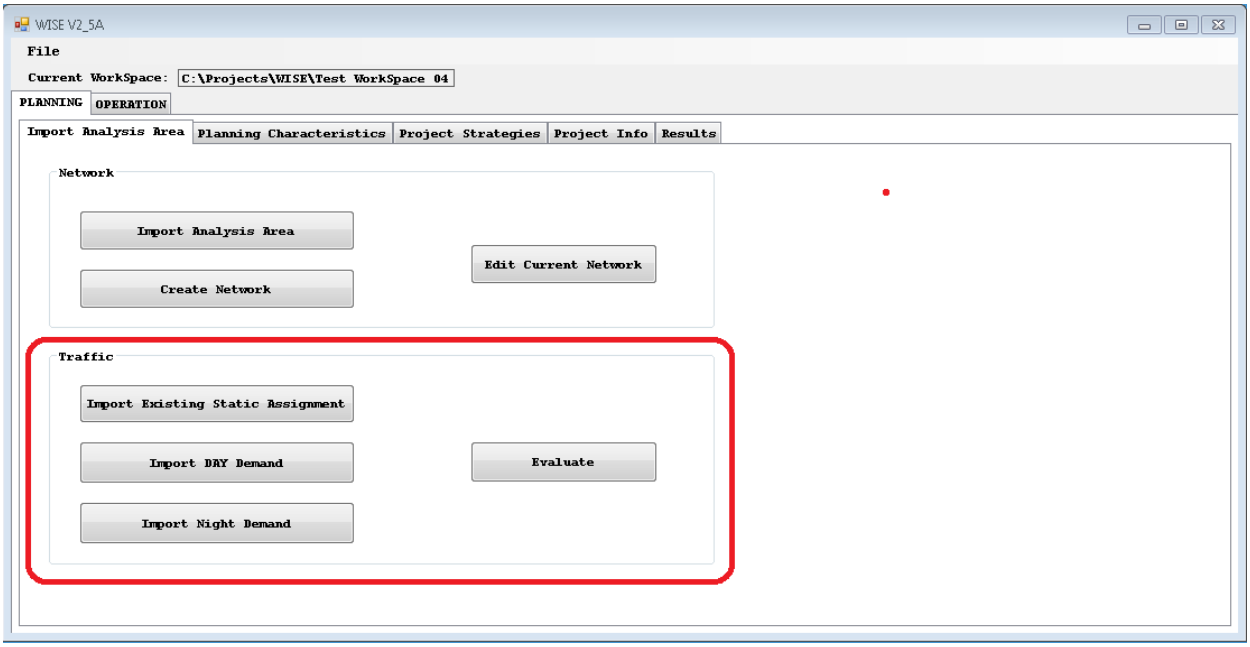


Figure 26: Import Analysis Area Tab: Traffic

Static Assignment in WISE

WISE has the capability to execute its own static assignment algorithm if the user does not have static assignment results (see "Static_Import.csv" from the "Importing Traffic Information" discussion in section 5 in this user guide).

WISE implements an Origin-Based Algorithm called Algorithm B[1]. To run the static assignment algorithm, the network and the demand that is imported from "Importing Traffic Information" in Section 5 must be in place. Figure 26 shows the buttons used to run the algorithm. At least "Import DAY Demand" or "Import NIGHT Demand" must have been imported before running the algorithm. The "Evaluate" button will run the algorithm.

Once the algorithm is completed, the "Static_Import.csv" file will be produced in the same format as explained in "Input file preparation" in Section 5.

Defining Planning Characteristics

Planning Characteristics for the entire program under evaluation are defined under ***Planning Tab -> Planning Characteristics*** as seen in Figure 27. All Planning Characteristic fields must be populated with valid values for the WISE Analysis Engine to run. The Planning Characteristics consist of the Season Factor for each month of the year (defaults to 1), Start and End time of the entire program (MM/YYYY Format), Value of Time for the program (dollars per hour), Demand Number of Hours for Day and Night, and a Program Description. To enter the Planning Characteristics values, select the text box associated with each and enter the value. Once you have entered all Planning Characteristics, you can validate all fields on the Planning Characteristics Tab by clicking ***Validate Planning Characteristics*** at the bottom of the tab. If there are any invalid values, the text box for all invalid values will be highlighted red. Please see Section IX, Data Limits, for details on valid values for each Planning Characteristic.

[1] Dial, R. A path-based user-equilibrium traffic assignment algorithm that obviates path storage and enumeration. Transportation Research Part B: Methodological, Volume 40, Issue 10, 2006, 917-936

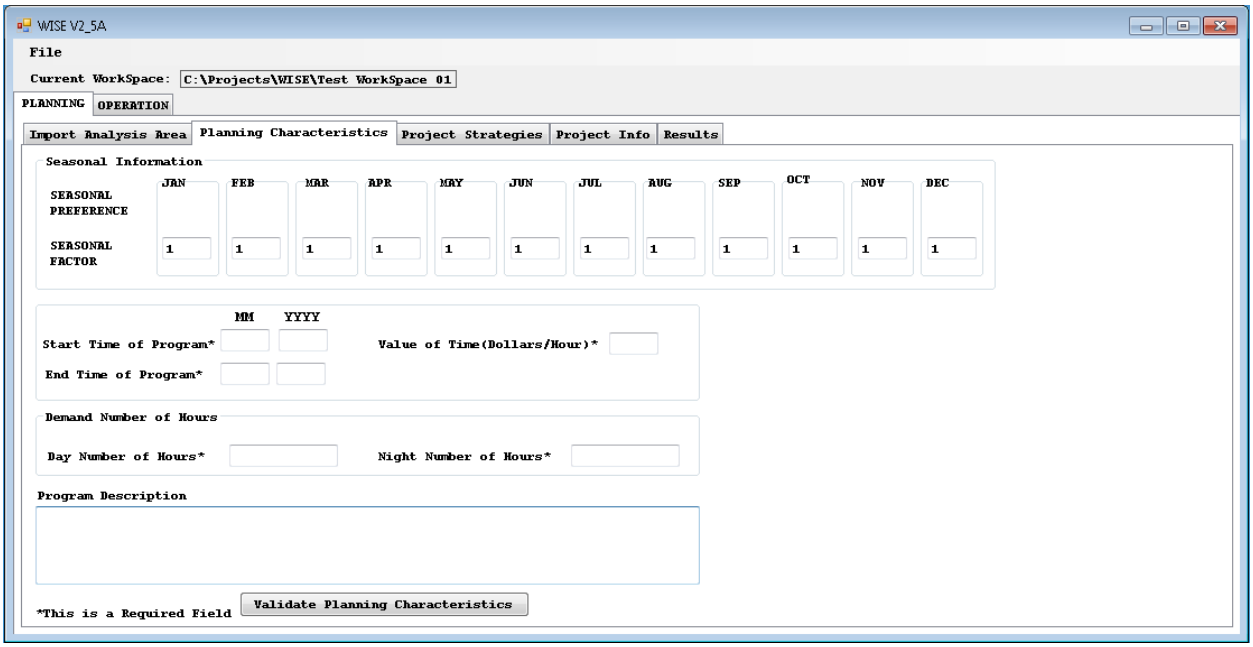


Figure 27: Planning Characteristics Tab

Project Strategies

Each WorkSpace must contain at least one strategy to be assigned to Projects within the WorkSpace. Project Strategies are created from the ***Planning Tab -> Project Strategies*** seen in Figure 28. Strategies are either Demand-Based or Duration-Based. You can enter strategies individually or import and export all strategies**.** Please see Section IX, Data Limits, for details on valid values for each Project Strategy.

WISE allows users to evaluate a wide range of strategies. These strategies can be broadly classified as Demand-based or Duration-based. All strategies either help reduce demand close to the work zone, or reduce the duration of the work zone (Table 1). For example:

(1) Daytime and nighttime

As the usual night demand is much lower than the day demand, undertaking work zones at night might have very little impact on the traffic and thus save considerable user cost compared with working in the daytime. However, scheduling work zones at night usually costs more real dollars from the agency's budget. There is a tradeoff between the magnitude of user cost and agency cost that planners and policy makers must address. See item 5 below for how this can be addressed in WISE.

(2) Seasonal impact

Another usual factor affecting the cost induced by work zone scheduling is the seasonal factor. It is well known that traffic demand varies among seasonal periods month by month. Particularly in tourism areas, for example, demand during non-peak periods is much lower than during the tourism peak.

Conducting work zone implementation during reduced demand periods certainly saves user cost. The tool also allows users to put constraints on the months of the year during which renewal cannot take place, for example, during the winter months with heavy snowfall.

(3) Demand reduction factor

Before work zone implementation, agencies usually carry out large-scale public involvement campaigns, which may reduce the local demand near the projects, e.g., non-work based discretionary trips such as shopping trips or tourism trips. This local demand reduction is measured by the demand reduction factors.

(4) Traffic diversion impact

With the presence of a work zone in the network, traffic usually diverges through a day-to-day learning process and continues toward a new equilibrium. This diversion effect involves a new traffic assignment computation in the work zone scheduling framework. Users can adopt the default WISE calculation for diversion, enter a value based on local knowledge or experience, or run the WISE Operations module to develop a microscopic simulation value for diversion.

(5) Putting weight on user cost with respect to monetary cost of the project

WISE utilizes a general cost that combines both agency and user costs to measure whether a project is cost-effective or not. Agency cost refers to the monetary expenses related to work zone project constructions; its unit is the dollar. User cost refers to the user travel time; its unit is the vehicle-minute.

WISE utilizes a user-specified parameter, Value-of-Time (VOT), to convert vehicle-minute of users' travel time to monetary dollars. The unit of VOT is dollar/vehicle-minute. It is recognized that an agency may value in a different way between monetary dollars and the user cost that is converted by VOT, which the modeler should take into account by a careful specification of VOT. For example, the general recommended value of VOT is in a range of one third to one half of the average hourly wage rate in the specified work zone construction area. However, an agency usually weights different values between monetary dollars and user cost that is converted by VOT. For instance, we say the agency cost is equivalent to the user cost by a factor of 2, meaning every 2 dollars of the user cost that is converted by VOT merits 1 monetary dollar. In this instance a modeler should adjust the VOT by half, so that WISE computes the monetary dollars of the general cost consisting of monetary dollars spent in construction plus the user cost that is weighted only half of monetary equivalence.

(6) Fast Construction Techniques

Significantly reduces the duration but comes at increased cost.

Table 1: Classification of Strategies

	Demand-Based Strategies	Duration-Based Strategies
Operational	Dynamic Message Signs Daytime/Nighttime Work Signal Optimization	Programming/Design/Materials Improving Parallel Roads Scheduling around Critical Events Daytime/Nighttime Work
Planning	Public Information Improving Parallel Roads	Total vs. Partial Closures Incentive/Disincentive Contracting Short Duration Closures Project Sequencing Construction Techniques Daytime/Nighttime Work

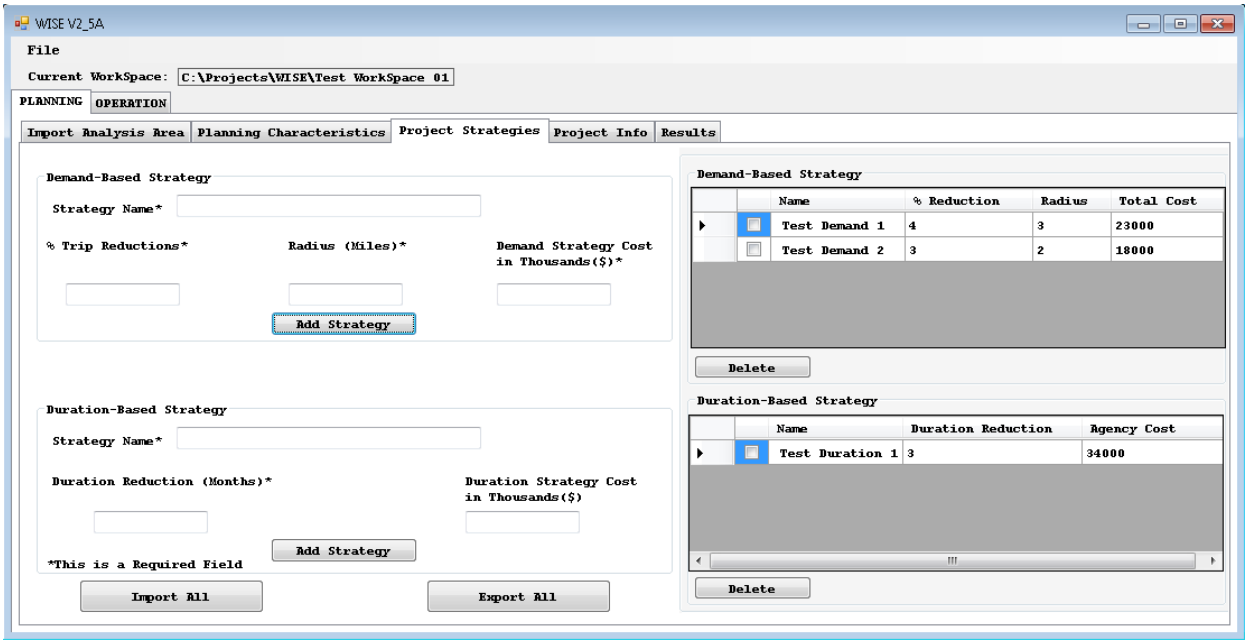


Figure 28: Project Strategies Tab

Demand-Based Strategies

To create a Demand-Based Strategy, in the Demand-Based Strategy box on the Project Strategy Tab, enter the Strategy Name, % Trip Reductions, Radius(in miles), and Demand Strategy Cost (in thousands of dollars). Once you have filled in all of the fields for the appropriate strategy, click ***Add Strategy*** in the Demand-Based Strategy box. **NOTE**: Each Demand-Based Strategy must have a unique name. If you duplicate a name, WISE will prompt you as to whether or not you

would like to write over the existing strategy. You can use this function to modify existing strategies by entering the exact name.

If an invalid value is entered, WISE will generate a warning and highlight the incorrect field in red without saving the strategy to the list of strategies.

Once you add a strategy, the strategy will be displayed in the Demand-Based Strategy List to the right of the GUI, as seen by "Test Demand 1" and "Test Demand 2" in Figure 28.

Duration-Based Strategies

To create a Duration-Based Strategy, in the Duration-Based Strategy box on the Project Strategy Tab, enter the Strategy Name, Duration Reductions (Months), and Demand Strategy Cost (in thousands of dollars). Once you have filled in all of the fields for the appropriate strategy, click ***Add Strategy*** in the Duration-Based Strategy box. **NOTE**: Each Duration-Based Strategy must have a unique name. If you duplicate a name, WISE will prompt you as to whether or not you would like to write over the existing strategy. You can use this function to modify existing strategies by entering the exact name.

If an invalid value is entered, WISE will generate a warning and highlight the incorrect field in red without saving the strategy to the list of strategies.

Once you add a strategy, the strategy will be displayed in the Duration-Based Strategy List to the right of the GUI, as seen by "Test Demand 1" in Figure 28.

Deleting Strategies

To delete a strategy, select the check box next to the strategy or strategies that you would like to delete within the list of current strategies to the right of the GUI on the Project Strategies Tab. Once you have selected all of the strategies you would like to delete for a given strategy type, select ***Delete*** at the bottom of the appropriate strategy listing (Figure 29).

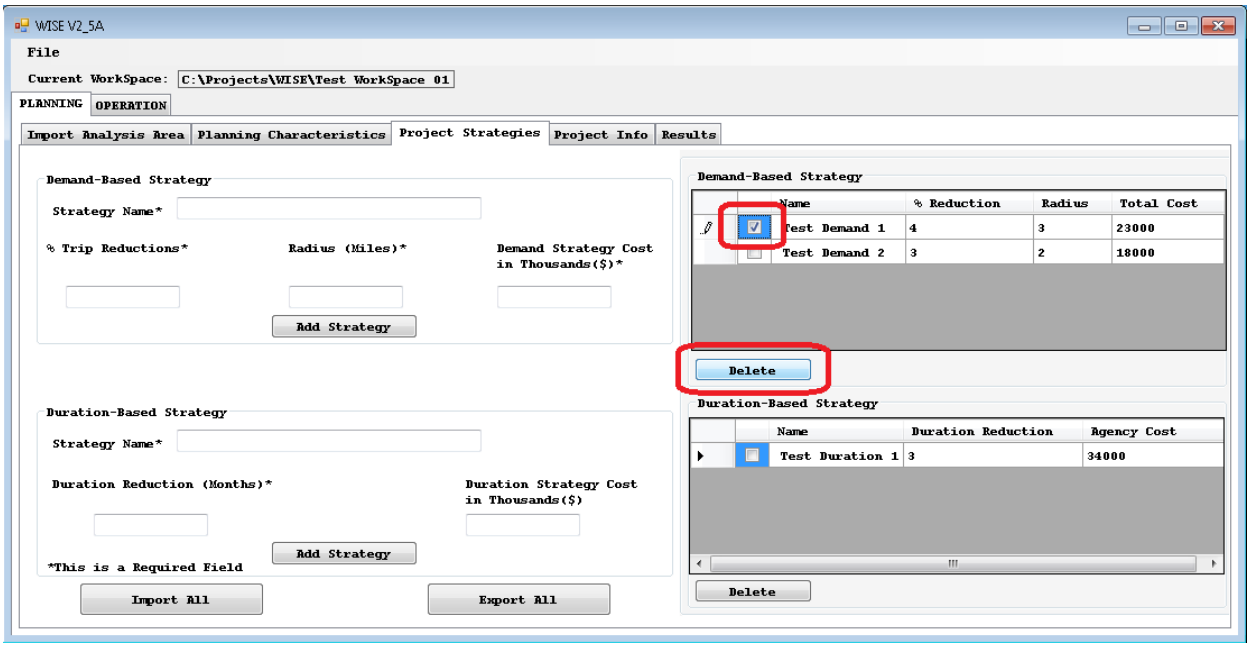


Figure 29: Deleting a Strategy

Import/Export Strategies

WISE GUI allows users to import and export listings of strategies. Importing and exporting of strategies will import/export all Demand- and Duration-Based Strategies at once. Please note that when you import strategies, you delete all strategies that were previously in the workspace. To import and export, select the ***Import*** or ***Export*** button at the bottom of the Planning Strategies Tab, and a browser window will open. Either navigate to the strategies that you would like to import or navigate to a folder and name the file that you would like to call the strategies you are exporting. **NOTE:** Importing strategies can only be done from WISE-generated strategy files.

Project Information

Creating Projects

All WISE WorkSpaces must have multiple Projects to perform an analysis. To create a project, the user must define a network with valid links, and at least one strategy. All Projects are managed from the ***Planning Tab -> Project Info*** (Figure 30). In the event that you modify a link or strategy after you have used it within a project, please see the section on "Viewing/ Modifying Projects" to modify the Project to update the strategy/links as needed.

A user can always identify how many projects are defined within a given WorkSpace by the Project Counter at the top of the ***Planning Tab -> Project Info*** (see Figure 30). In Figure 30 the Project Counter is "0" and the current Project you are working on is a "New" Project of the "0" Projects currently defined.

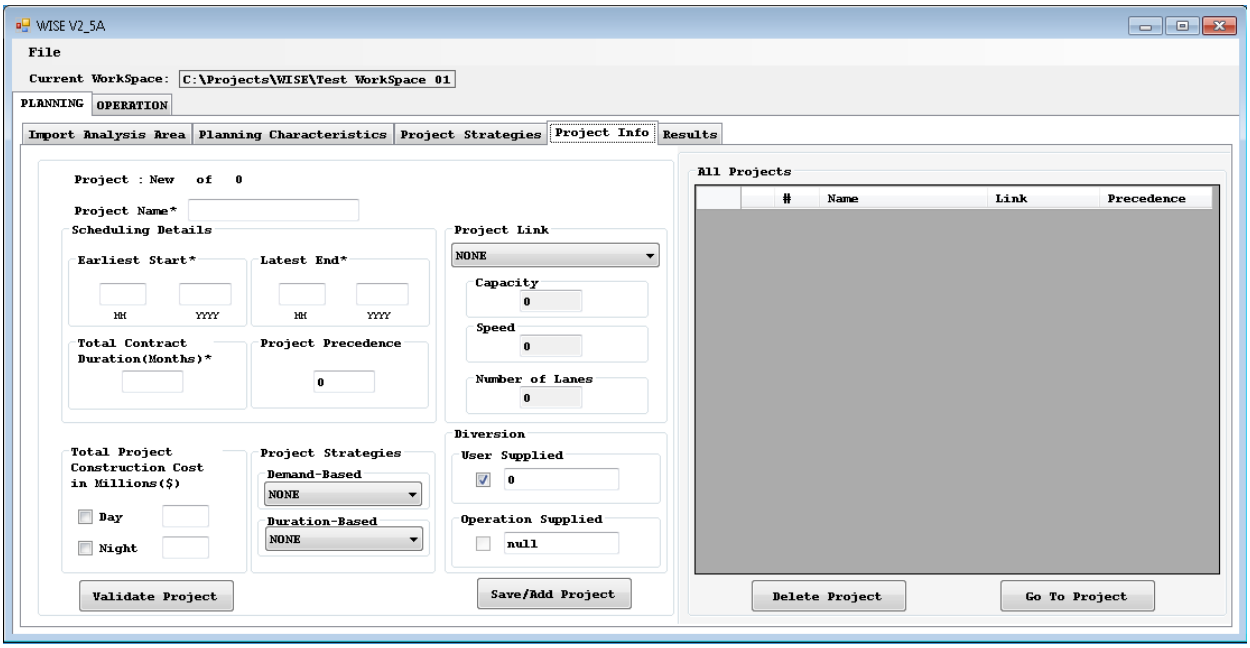


Figure 30: Project Information Tab

To create a new Project, navigate to the ***Project Info Tab*** within ***Planning*** and fill in the following fields by typing in the appropriate values: Project Name, Earliest Start Time and Latest End Time (MM/YYYY format), Total Duration of Project (in months), and Project Precedence. Also select Day and or Night and fill in the appropriate Total Project Construction Cost in millions of dollars (you can only fill in a cost for Day/Night if you select them). You must select at least one strategy from the Project Strategy pull down menus (one Demand- or Duration-Based Strategy or one of each). You must also select a Project Link from the pull down menu (selecting a Project Link will automatically populate the Capacity, Speed, and Number of Lanes fields). If the Project Strategies or Project Link pull down menus do not have any valid options, you either have not generated any strategies, have not imported a valid network, or all of your Project Links have already been assigned (each Link can only be assigned to one Project).

Prior to adding the new project, the user must also select a Diversion. If the user would like the WISE Diversion Engine to generate the Diversion automatically in the Planning Module, select User-Supplied and leave the value at "0." The Planning Module uses static assignment. The user also has the choice of supplying a Diversion other than "0", based on experience and judgment, or on separate studies. If additional accuracy for estimating potential traffic diversion due to construction delays is desired, the user can apply the DynusT model as part of the Operational function, develop diversion estimates in the Operational Module, and re-run the Planning module. Applying diversion estimates from the Operational Module is an explicit choice in the Planning Module. See the sub-section Diversion, below, for further information on Operation-Supplied Diversion. The Operation Module -Supplied Diversion will not be available for new projects until the Operation Module is run; until then the "Operation Supplied" box will indicate "null".

Once all Project information is completed, select ***Save/Add Project*** to add the Project to the Project list to the right hand side of the Project Info Tab. Upon clicking ***Save/Add Project***, WISE will validate all fields and highlight them in red if they are invalid. Once the project is Saved/Added, the GUI will return the Active Project screen to a New Project screen and the Project Counter will display New of Total so that new Projects can be added.

At any time during the generation or modification of a project, the user can click ***Validate Project*** and WISE will highlight all fields that have errors or display an "error free" message.

Please see Section IX, Data Limits, for details on valid values for each field within the Project Info Tab.

Viewing/Modifying Projects

A user must go to an existing Project either to view it or modify it using the ***Go To Project*** Button at the bottom of the list of All Projects on the Project Info Tab. To ***Go To*** a Project, the user must select the check box next to one project in the All Projects list and click ***Go To Project***, as seen in Figure 31. This will populate the Project screen to the left of the Project Info Tab with the selected Project. You can see that the current project counter will now display Project X of Total. The user can now modify all Project fields as done while creating a project and click Save/Add Project. This will perform the same validation and operation as creating a new Project and update the Project in the All Projects list. This will also return the Active Project screen back to New of Total so new Projects can be added.

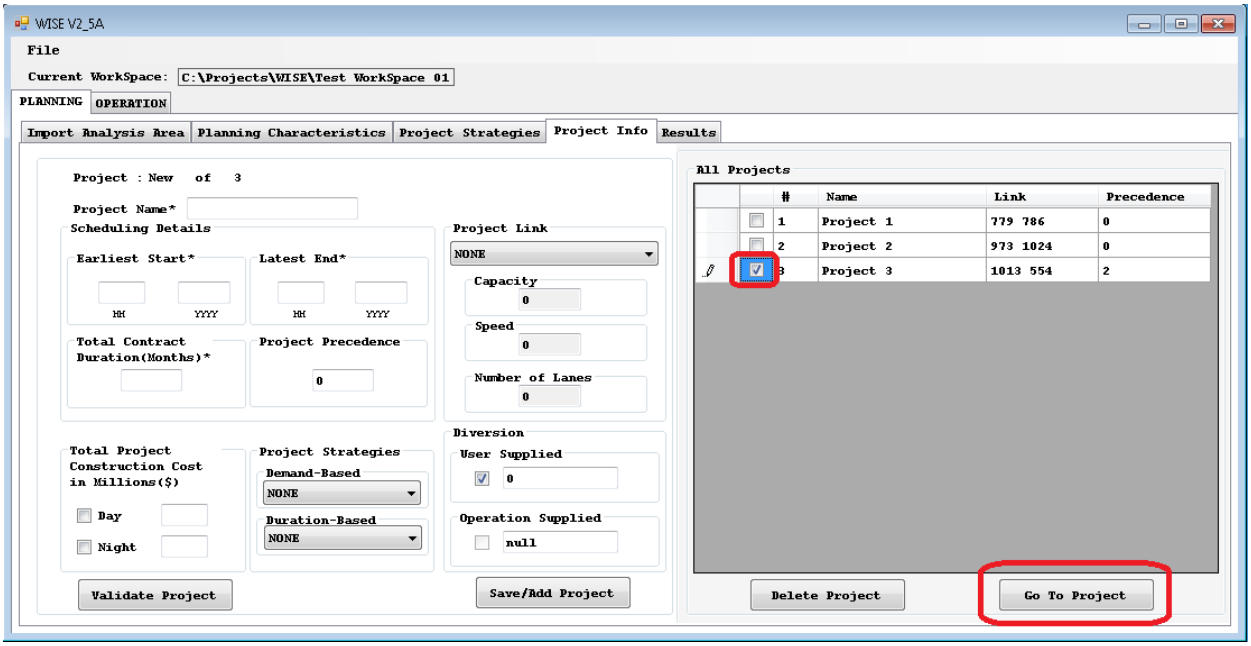


Figure 31: Project Information Tab: Viewing/ Modifying a Project

Deleting Projects

To delete a Project from the WorkSpace, select the check box next to the Project or Projects in the *All Project* List that you would like to delete, then select the **Delete Project**

button from the bottom of the list, as seen in Figure 32. WISE will delete all selected projects after prompting to ensure that you would like to delete as specified. Once a Project is deleted, it will no longer be seen in the All Projects List.

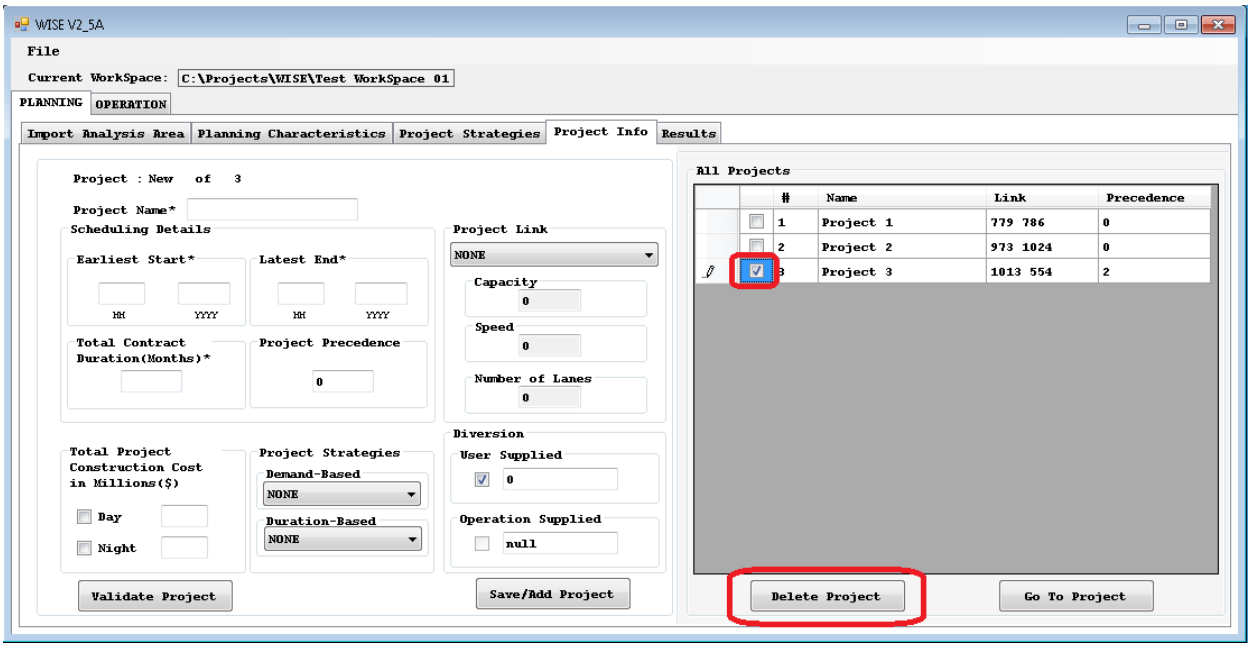


Figure 32: Project Information Tab: Deleting a Project

Planning Module WISE Analysis Engine

Once all necessary inputs are entered into the Planning Module of the current WorkSpace, the user can then choose to run the WISE Analysis Engine. To run the WISE Analysis Engine, the entire WorkSpace must complete a successful WorkSpace Validation and Save. The WorkSpace Validation and WISE Analysis Engine are run from the ***Planning -> Results Tab*** (Figure 33).

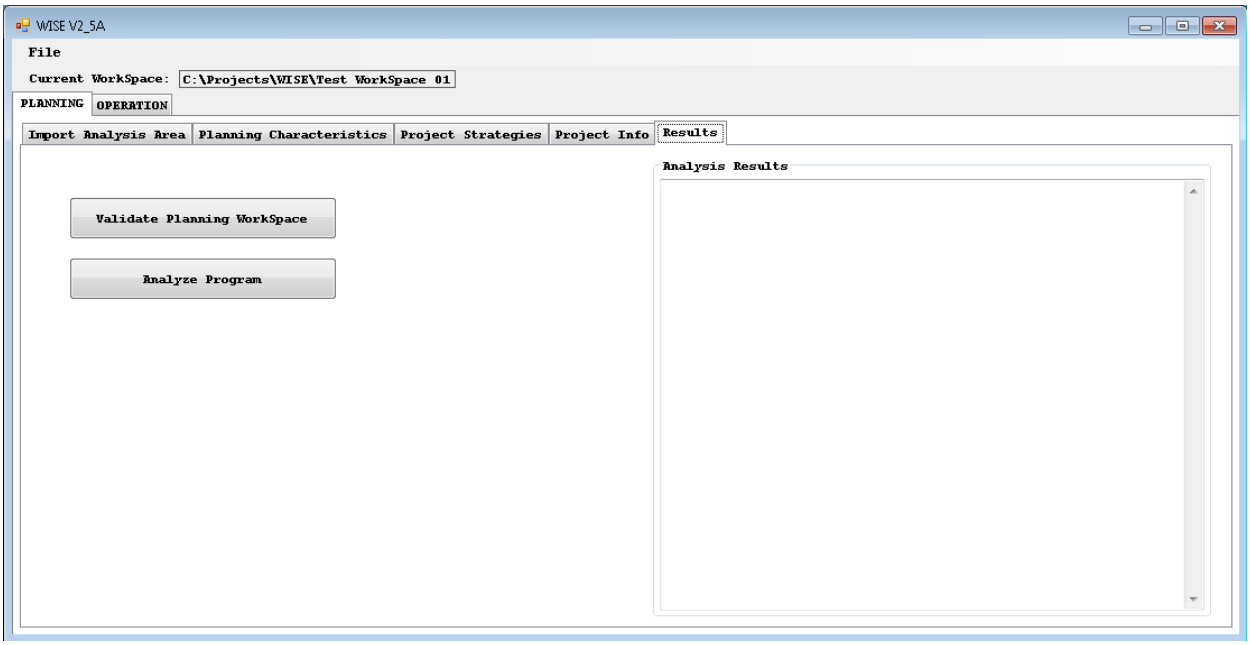


Figure 33: Planning Results Tab

Validation

To validate the entire WorkSpace, the User must select ***Planning Tab -> Results -> Validate Planning WorkSpace***. This function will validate the entire WorkSpace and generate an error log in the event that errors are detected. WISE will display the location of this error log in a pop-up window when needed. Validation of the Planning WorkSpace prompts the user to save the current WorkSpace and validates the following items:

- Check for valid network
- Ensure the following have not been modified since they were applied to a Project:
    - Link: including Speed/Capacity/Number of Lanes
    - Strategies
- Validate the following dates:
    - All Projects fit within program
    - Each Project Precedence is feasible (note- projects can also coincide)
    - All Duration-Based Strategies applied to Projects have feasible Duration Reduction for Project Duration

Running Planning WISE Analysis Engine

Once the WorkSpace is ready for analysis of the Planning Module, the user can select ***Analyze Program***, as seen in Figure 33, to run the WISE Analysis Engine. This can be selected from ***the Planning Tab -> Results -> Analyze Program***. The Analyze Program will first perform a Validate Planning Network and the run the WISE Analysis Engine if all validations are clear. When the WISE Analysis Engine is running, the user will see a command window running the Analysis Engine. At the completion of the

WISE Analysis Engine, the Analysis Results Box will populate on the ***Planning -> Results Tab*** under the ***Analysis Results*** Section (see Figure 33). Please see **Display/Interpretation of Results** (near the end of this section) for more information on the analysis results.

Diversion

WISE performs traffic diversions in the sequencing algorithm in the planning module to analyze interdependency of work zone construction projects and the resultant traffic impact and delays network-wide, and recommends a feasible sequence with a rule of minimum traffic delay over the studied seasons and period that the algorithm can find. Although the traffic diversion is an internal analytical analysis module packaged with the sequencing algorithm, WISE is able to execute traffic diversion under three different modes: WISE-supplied, user-supplied, and operation-supplied. Technical details of traffic diversion analysis in WISE are discussed in "Optimization of Project Sequence."

WISE-Supplied

This is the default setting. If no traffic diversion information is supplied by users or the operation model, WISE executes the default mode automatically. Under this mode WISE analyzes traffic diversions through an internal logic, which finds a set of alternative routes to the route going through the work zone construction link. WISE analyzes if the work zone construction link involves congestion, and if so, a portion of traffic on the work zone construction link is diverted to the set of alternative routes if doing so leads to less delay. The internal logic seeks an equilibrium state between the work zone link/route and its alternative routes. Analytically, the WISE-supplied diversion module achieves equal travel time between both (sets of) routes.

To enable the WISE-supplied traffic diversion rate, keep the "user supplied" box checked, and input the number zero in the box (Figure 34).

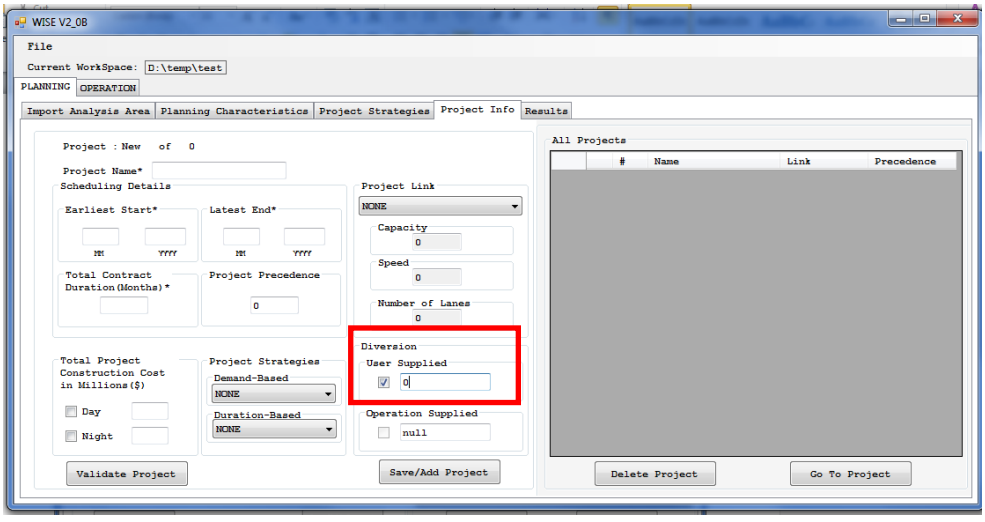


Figure 34: Defining WISE-Supplied Traffic Diversion Rate

User-Supplied

WISE also provides an interface that allows users to provide a traffic diversion rate, if such information is known by those who are familiar with local traffic performance or is obtained by additional traffic studies outside WISE. To execute the user-supplied mode, select “user supplied diversion” on the page “Project Info” and insert a positive number (at least 1 and no more than 100) in the box (Figure 35). For example, the number in Figure 35 stipulates that 15% traffic on the work zone construction link is to be diverted to the set of alternative routes.

Given the user-supplied traffic diversion rate, WISE still finds a set of alternative routes to the route going through the construction link, as in the default mode, and diverts the user-supplied portion of traffic from the work zone construction link to the alternative routes regardless of the computed travel time.

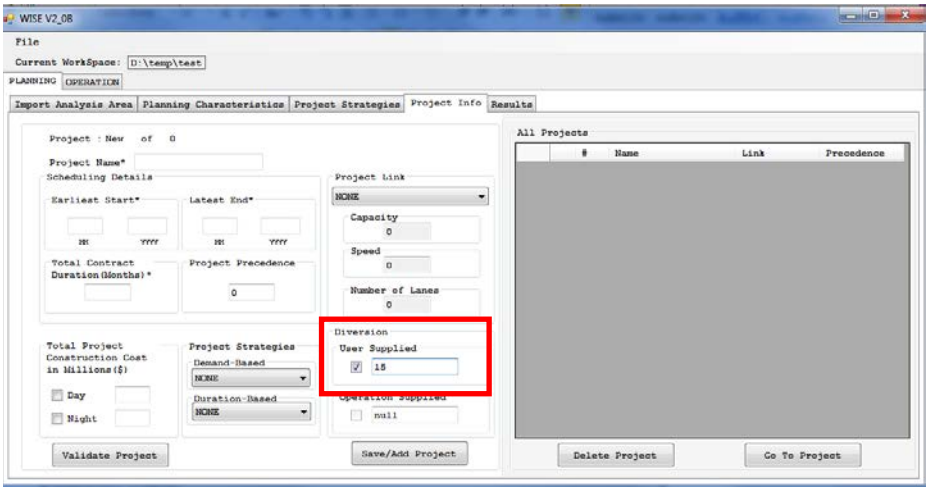


Figure 35: Defining User-Supplied Traffic Diversion Rate

Operation-Supplied

The operation-supplied diversion rate provides an interface to feed the traffic diversion data analyzed in the operation module back to the planning module (Figure 36), hence the handshake between the planning and operation models in WISE. To enable this mode, users must perform the operation module in WISE first. Without the analysis data produced by the operation module in WISE, the operation-supplied check box is grayed and not checkable.

After running the operation module and with the traffic data produced by WISE, the check box becomes activated. When the check box is selected, WISE identifies the simulation dataset and reads the produced outputs internally, and a diversion rate number pops into in the box automatically.

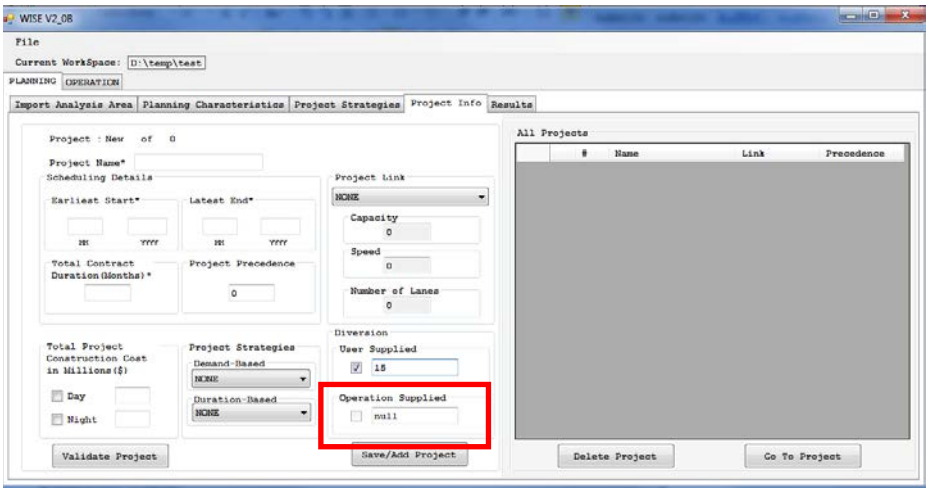


Figure 36: Defining Operation-Supplied Traffic Diversion Rate

Project Information Tools

Running the Algorithm

Validate Planning Workspace

Upon completion of project setup right before proceeding to execute the program, the user can click “Validate Planning Workspace” to ensure that the input numbers are valid. This step provides an additional safeguard to check that the numbers of project setup are feasible within a reasonable domain supported by WISE. Invalid numbers and inputs will be popped up in a warning message. The program is not able to run until all invalid inputs identified by “validation procedure” are cleared.

Analyze Program

The “Analyze Program” button executes the sequencing algorithm in WISE, to analyze traffic delays in the network with the project setup. The sequencing algorithm evaluates interdependency of construction projects as well as the resultant traffic delays under a set of logically generated feasible schedules, and recommends the best schedule plan with the minimum generalized cost that the program evaluated.

Display / Interpretation of Results

When the analyzing program is completed, the sequence results are automatically popped up in the “Analysis Results” box on the right side of program window (Figure 37).

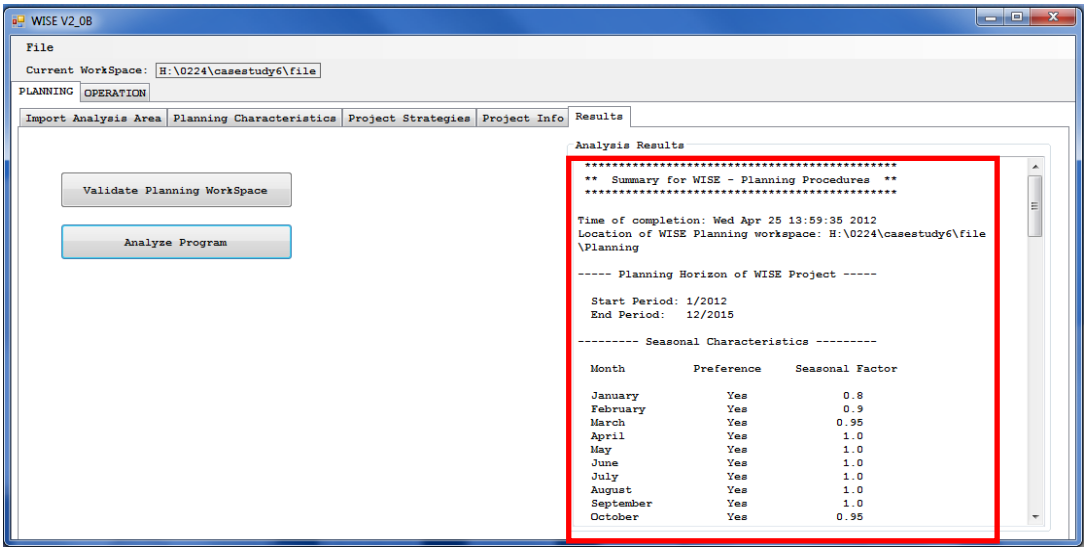


Figure 37: Displaying Analysis Results

The first part of the WISE output summarizes basic inputs of the analyzed scenario. It displays the overall planning horizon, month-specific seasonal factors, and number of projects specified by inputs.

The second part of the WISE output displays the recommended sequence of each project, as well as its associated traffic variables, in an order of construction modes following daytime construction, nighttime construction, and both.

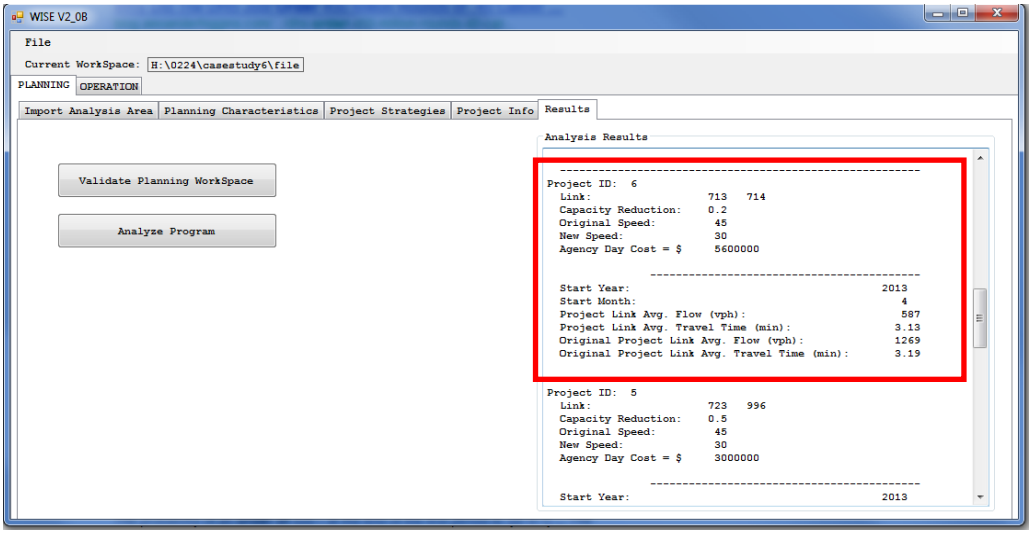


Figure 38: Displaying Project Sequence and Its Associated Traffic Variables

Figure 38 shows an example of displaying the project sequence result in the output. It sets forth a quick summary of Project setup, including Project ID, link where the Project resides, capacity reduction rate, original posted speed limit, new posted speed limit during construction, and agency cost involved for implementation.

The recommended Project sequence follows. It displays the recommended year and month to start construction. Completion time is not displayed in the outputs, but the user can compute completion time given starting construction time and project duration (taking into account any duration-based strategy). The result also displays the average flow, in units of vehicles per hour, and average travel time, in units of minutes, on the work zone construction link. Those numbers are averaged by work zone construction period. For example, if a work zone project lasts for three months, the displayed flow and travel times are averaged over three months. To facilitate a comparison, the output also displays the original flow and travel time before construction. Again those are annual average numbers. Usually one may see a reduced flow with increased travel time. Reduced flow implies WISE analysis traffic diversion for the analyzed work zone project. Two factors lead to an increased travel time: the drop of capacity, and the reduced posted speed limit during construction.

Optimization of Project Sequence

WISE selects the best schedule plan based on the generalized cost, which contains both user cost and agency cost. User cost is also known as traffic delays, measured by vehicle hour prolonged for all travelers in the network arising from the work zone constructions. Traffic delay is converted to user cost by multiplying value of time.

$$user\ cost = traffic\ delay\ (hrs) \times value\ of\ time\ (\$/hr)$$

Agency cost stands for the monetary dollars spent out-of-pocket to implement the evaluated construction plan. Agency cost is specified by users when defining demand-based and duration-based construction strategies. See work zone construction strategies in Section IV.

With the user cost derived from traffic delay, plus the agency cost, WISE evaluates the generalized cost summarized for the entire analysis period. Logically, WISE generates a number of evaluated schedule scenarios and eventually selects the best one with the minimum whole-period generalized cost among all schedule plans that the program has evaluated.

The main task of the sequencing algorithm is to evaluate traffic delay in computing user costs. Note that traffic delay varies month to month because of geometric features of the network (e.g., links are partially closed for construction in a specific month), travel demand varies month to month, and delays are scenario-specific depending on the individual construction schedule plan. In this regard WISE evaluates traffic delay for each month and then summarizes the overall delay for the entire analysis period.

For a specific month traffic delay is measured in a manner considering the traffic diversion effect. It is assumed that some travelers will respond to the construction event and choose their own alternate route to minimize their own delay. Considering the traffic diversion effect highlights the need to measure the interdependency of work zone projects. If two work zone projects are located where one is an alternative route to the other, the algorithm is able to measure a worse delay when construction is concurrent rather than sequential. As a general rule interdependent projects are usually not recommended for construction in overlapping time windows as that leads to worsen traffic delay.

Delay caused by work zone construction network-wide is measured by a k-shortest path (KSP) algorithm that appropriately captures travelers' diversion. The KSP algorithm in WISE is a revised version of the ranking algorithm based on the work of Martins (1983). As a general rule it finds the shortest path one by one between a set of diversion points and merging points. More specifically, WISE identifies a set of upstream nodes $r$of a work zone project as diversion points, and specifies a set of downstream nodes $s$as merging points, and then solves k shortest paths between sets r and s. A set of paths among KSP that leads to a shorter travel time than the one going through a construction link is specified as a set of alternative routes for traffic diversion. Traffic diversion shifts flow from the longer route (in time) to a shorter route, so that travel times along two routes are identical after flow shifting, indicating an equilibrium state.

A set of feasible schedules is generated by a large-scale neighborhood search heuristic. A feasible schedule, or plan, means that the schedules identified for each project satisfy the earliest starting time and latest completion time, the duration is within the domain that users specify, and the precedence constraints, if any, are valid. The heuristic starts from a feasible schedule plan, computes month-specific traffic delay, and obtains the overall generalized cost for the entire analysis period. Based on the current plan and evaluation result, WISE generates another plan that may lead to an improvement and performs the same evaluation again. In each iteration the heuristic usually identifies a better plan. The analysis procedure continues until the program cannot identify further improvement within a certain number of iterations.

II. Planning Module Detail Elements

Getting a Dataset into WISE – Converting a Dataset into NEXTA Format

Network Conversion

DynusT adopts a flexible and robust interface — an Excel template file — approach with existing GIS-based demand forecasting/network planning software packages. This information provides the appropriate stages of the process of importing an existing network, i.e., links, nodes, and zones, to a DynusT dataset. An Excel template is included in the software package, located in the directory in which the software is installed (file name: *GIS_Network.xls*). The typical path to this folder is *C:\Program Files \DynusT 3.1 (32 bit)*.Because DynusT is a simulation-based model, typically the centroids and centroid connectors from a static network are not used and are removed. For the purpose of DynusT in WISE, it is optional for the user to remove or leave in the information. The removal of centroids and centroid connectors from the dataset can be done either in the existing planning software from which the importing network originates, or by carefully modifying these items from the Excel conversion template. An overall explanation of the centroid methodology can be found at http://dynust.net/wikibin/doku.php?id=start:getting_started#generation_links_and_destination_nodes. ((DynusT Wiki Online Help, 2011))

The general procedure for network conversion is as follows.

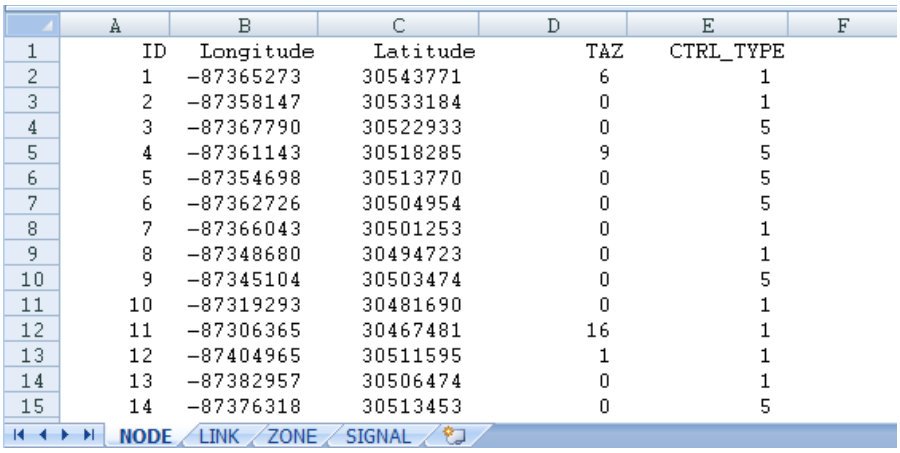
1. Export network related tabular information regarding nodes, links, and zones from the original network modeling software. Most software packages can export this information either as an Excel file or as a comma-delimited file (*.csv).
2. Copy the node, link, and zone information to the appropriate worksheet in the Excel template file.
3. Import the Excel template file to NEXTA to convert the network to DynusT format.

The following describes the necessary information to copy into the Excel template file.

NODE Worksheet

This worksheet contains the following columns and is shown in Figure 39:

- ID
- Longitude
- Latitude
- TAZ
- CTRL_TYPE



	A	B	C	D	E	F
1	ID	Longitude	Latitude	TAZ	CTRL_TYPE	
2	1	-87365273	30543771	6	1	
3	2	-87358147	30533184	0	1	
4	3	-87367790	30522933	0	5	
5	4	-87361143	30518285	9	5	
6	5	-87354698	30513770	0	5	
7	6	-87362726	30504954	0	5	
8	7	-87366043	30501253	0	1	
9	8	-87348680	30494723	0	1	
10	9	-87345104	30503474	0	5	
11	10	-87319293	30481690	0	1	
12	11	-87306365	30467481	16	1	
13	12	-87404965	30511595	1	1	
14	13	-87382957	30506474	0	1	
15	14	-87376318	30513453	0	5	

NODE LINK ZONE SIGNAL

Figure 39: NODE Worksheet

The ID column is the node ID, and the IDs should be consistent with their association with the network links, meaning that the node IDs used to describe links in the "L" section should be consistent here. The Longitude and Latitude columns contain the X and Y coordinates of each node. It should be noted that any coordinate plane format is accepted as NEXTA will convert it to its own coordinate system. The TAZ column indicates each node's association with a TAZ, i.e., the node is within the geographical boundary of the TAZ. If for any reason a node does not have a TAZ, the user may insert a "0." The "CTRL_TYPE" column refers to the type of traffic control designated to that node. Table 2 describes each control type's identification record. It is suggested that the user set up default actuated signal control. More information can be found at

http://dynust.net/wikibin/doku.php?id=start:getting_started#default_control_signals (DynusT Wiki Online Help, 2011).

. The traffic control types are listed below.

Table 2: Traffic Control Types for Nodes

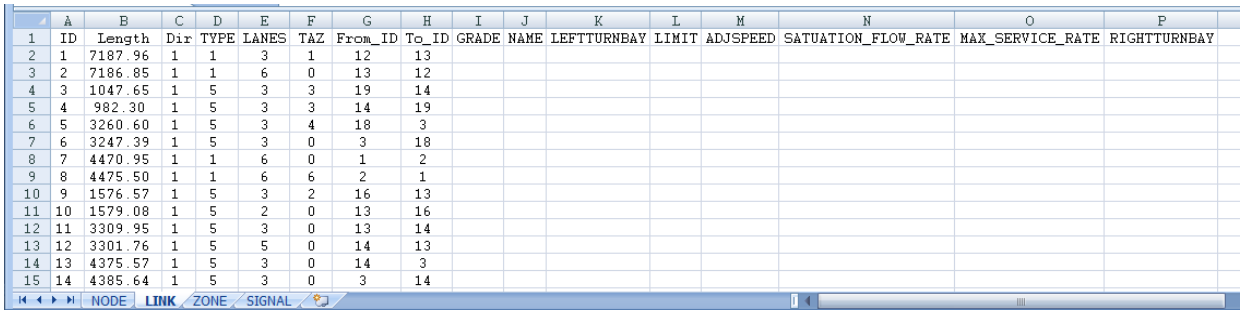
Type	Description
1	No Control
2	Yield Sign
3	4-Way Stop Sign
4	Pre-Timed Signal Control
5	Actuated Signal Control
6	2-Way Stop Sign

LINK worksheet

This worksheet contains the following columns and is shown in Figure 40:

- ID
- Length
- Dir

- Type
- Lanes
- TAZ
- From ID
- To ID
- Grade*
- Name*
- LeftTurnBay*
- Limit*
- AdjSpeed*
- Saturation_Flow_Rate*
- Max_Service_Rate*
- RightTurnBay*



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	ID	Length	Dir	TYPE	LANES	TAZ	From_ID	To_ID	GRADE	NAME	LEFTTURNBAY	LIMIT	ADJSPEED	SATUATION_FLOW_RATE	MAX_SERVICE_RATE	RIGHTTURNBAY
2	1	7187.96	1	1	3	1	12	13								
3	2	7186.85	1	1	6	0	13	12								
4	3	1047.65	1	5	3	3	19	14								
5	4	982.30	1	5	3	3	14	19								
6	5	3260.60	1	5	3	4	18	3								
7	6	3247.39	1	5	3	0	3	18								
8	7	4470.95	1	1	6	0	1	2								
9	8	4475.50	1	1	6	6	2	1								
10	9	1576.57	1	5	3	2	16	13								
11	10	1579.08	1	5	2	0	13	16								
12	11	3309.95	1	5	3	0	13	14								
13	12	3301.76	1	5	5	0	14	13								
14	13	4375.57	1	5	3	0	14	3								
15	14	4385.64	1	5	3	0	3	14								

NODE | LINK | ZONE | SIGNAL

Figure 40: LINK Worksheet

The ID column is not necessarily used in DynusT; instead it is a reference for the user, but is necessary. The Length column contains the length of each link in feet. The Dir column should contain a 0, 1 or -1 value. All links in DynusT are directional, and DynusT will convert links that are bi-directional into two separate links in opposing directions. The Type column refers to the link's functional class or functional type. Table 3 describes each link type's identification record. The user must aggregate link classes from the planning network to these classes used in DynusT. Additional classes cannot be made or recognized in DynusT.

Table 3: Link Functional Classes

Type	Description
1	Freeway
2	Freeway Segment with Detector (for Ramp Metering)
3	On-Ramp
4	Off-Ramp
5	Arterial
6	HOT
7	Highway
8	HOV
9	Freeway HOT

10	Freeway HOV

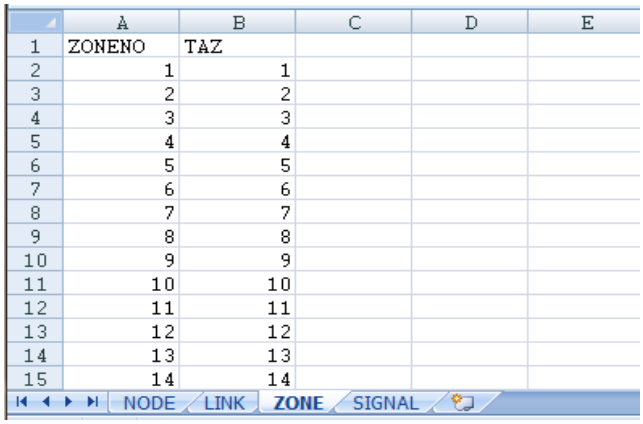
The Lanes column represents the number of lanes in each directional link. As stated earlier, all links in DynusT are directional links. Since many planning tools represent links by one link that is marked as bi-directional, the user must be diligent if creating a bi-directional link from one link listed. Near the end of this section is a description of the possible warning message that NEXTA may give in the eventual import of the Excel template file. The TAZ column indicates each link's association with a TAZ, i.e., the link is within the geographical boundary of the TAZ. If for any reason a link does not have a TAZ, the user may insert a "0." The From ID and To ID columns are the start node and end node of a link. As mentioned in the "NODE" Worksheet section, these node IDs should be listed in the NODE worksheet.

The remaining columns (denoted by a * in the listing above) are filled at the user's discretion; default settings will be applied to these column fields if not filled. The Grade column contains the % highway grade of the link. The Name column designates the name of the link. The LeftTurnBay column contains the number of left turn bays downstream of the link. The Limit column is the speed limit of the link mph. The AdjSpeed column is a speed adjustment factor applied to the speed limit. The Saturation_Flow_Rate column contains each link's saturation flow rate. This value is used for arterial links because the saturation flow rate is measured at intersections. DynusT uses this value for all arterial links, and the remaining link types will not use this value. The Max_Service_Rate column contains each link's maximum service flow rate. The RightTurnBay column contains the number of right turn bays.

ZONE worksheet

This worksheet contains the following columns, and is shown in Figure 41:

- ZoneNo
- TAZ



	A	B	C	D	E
1	ZONENO	TAZ			
2	1	1			
3	2	2			
4	3	3			
5	4	4			
6	5	5			
7	6	6			
8	7	7			
9	8	8			
10	9	9			
11	10	10			
12	11	11			
13	12	12			
14	13	13			
15	14	14			

NODE | LINK | ZONE | SIGNAL

Figure 41: ZONE Worksheet

The ZoneNo column must be in increasing, consecutive order starting from "1." The TAZ column should be filled with the actual TAZ IDs from the planning model. One should note that in a typical planning model, the TAZ number designation could be a sequence with skipped numbers not necessarily

starting from a TAZ ID of 1; however, DynusT requires the zone number to start from 1 with consecutive numbers. This worksheet maintains the mapping between the DynusT zone number and the actual TAZ numbers from the planning model.

SIGNAL worksheet

This worksheet contains the following columns and is shown in Figure 42:

- MaxGreen
- MinGreen
- Amber

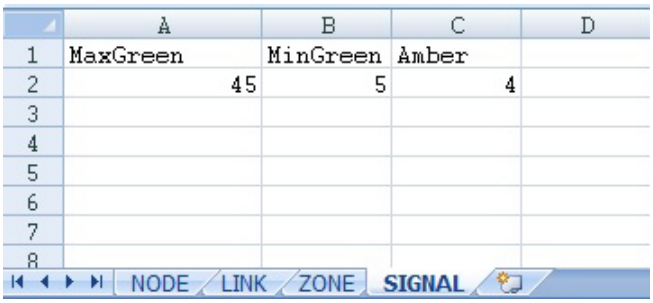


Figure 42: SIGNAL Worksheet

As noted in the NODE Worksheet section, default traffic control can be placed on nodes. Because of the great possibility that the network is of a large, regional area, the size of the network may be too significant, as well as time consuming, to manually place signals for every intersection. It may be more realistic to indicate "default" traffic signals applied to the whole network from the start. This worksheet allows the user to quickly assign a default actuated signal control. After the conversion process the user may manually change signal timings if desired. Please note that the default signal type can only be actuated, e.g., not "pretimed" or "none."

Importing

Once the Excel template file is prepared, the user can import this file by going to *File* → *Import Files* → *Import GIS Data Set* → *Import Network Table*, as shown in Figure 43. Please note that NEXTA must have a new, blank Project open. To do so, go to *File* → *New*.

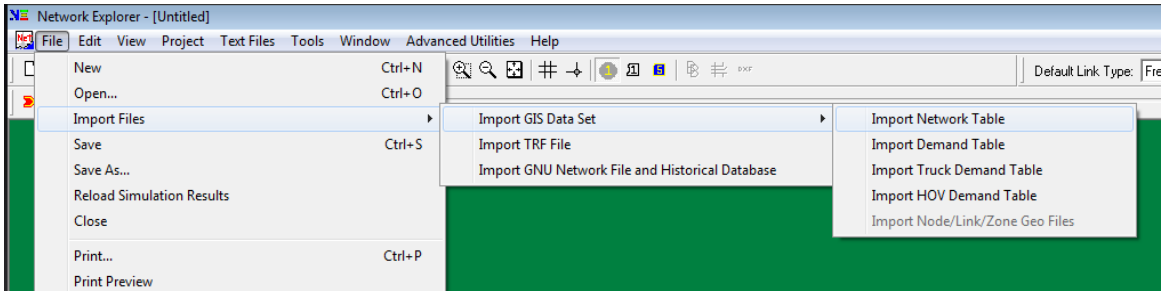


Figure 43: Importing the Excel Template File

As mentioned previously pertaining to the indication of the number of lanes and bi-directional links, NEXTA will ask the following question as a warning when converting the Excel template file: “Is the number of lanes on a two-way link for one direction only?” (Figure 44).

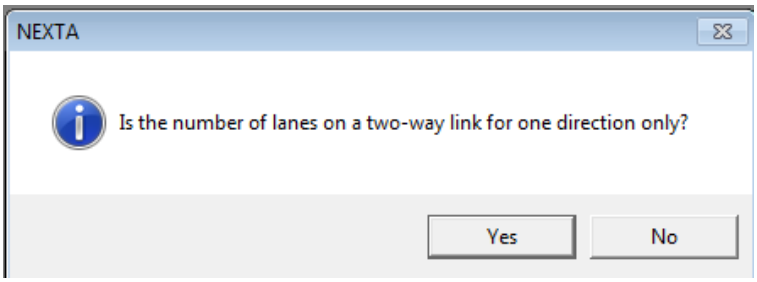


Figure 44: NEXTA Link Direction Warning

This statement refers to links in the spreadsheet that are labeled with Dir = 0, and whether the number of lanes for that link are for one direction or “split” the link evenly to create bi-directional links. In other words, answering “Yes” imports the links as a 1, which is one-directional, and answering “No” imports the links as a 0, which is bi-directional.

Once complete, the user will be able to see the network produced on NEXTA. Simply save the network by going to *File* → *Save*, create a new folder to contain all input files, and give a name to the project file to complete the conversion process.

For more information regarding the conversion process and other information regarding DynusT and NEXTA, please visit the online user’s manual at http://dynust.net/wikibin/doku.php?id=start:getting_started#importing_datasets. (DynusT Wiki Online Help, 2011).

Creating a Network from Scratch

To create a network from scratch, click on “Create Network” button under the “Import Analysis Area” tab of the Planning Module in WISE, as shown in Figure 45. This will open the NEXTA interface.

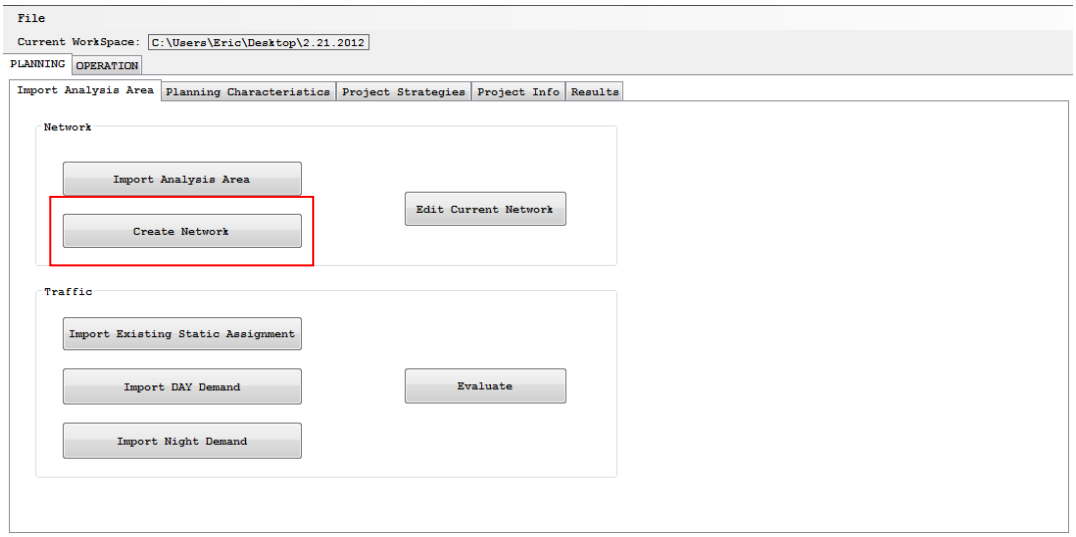


Figure 45 "Create Network" button

Once NEXTA is open, a new, blank NEXTA Project should already be opened. If it is not, simply click on *File* → *New* in NEXTA. This will create a blank project. You can create new nodes, links, and zones using the network creation tools, as demonstrated in Figure 46. For more information visit the DynusT and NEXTA online user manual at the following link: http://dynust.net/wikibin/doku.php?id=start:getting_started#network_basics.

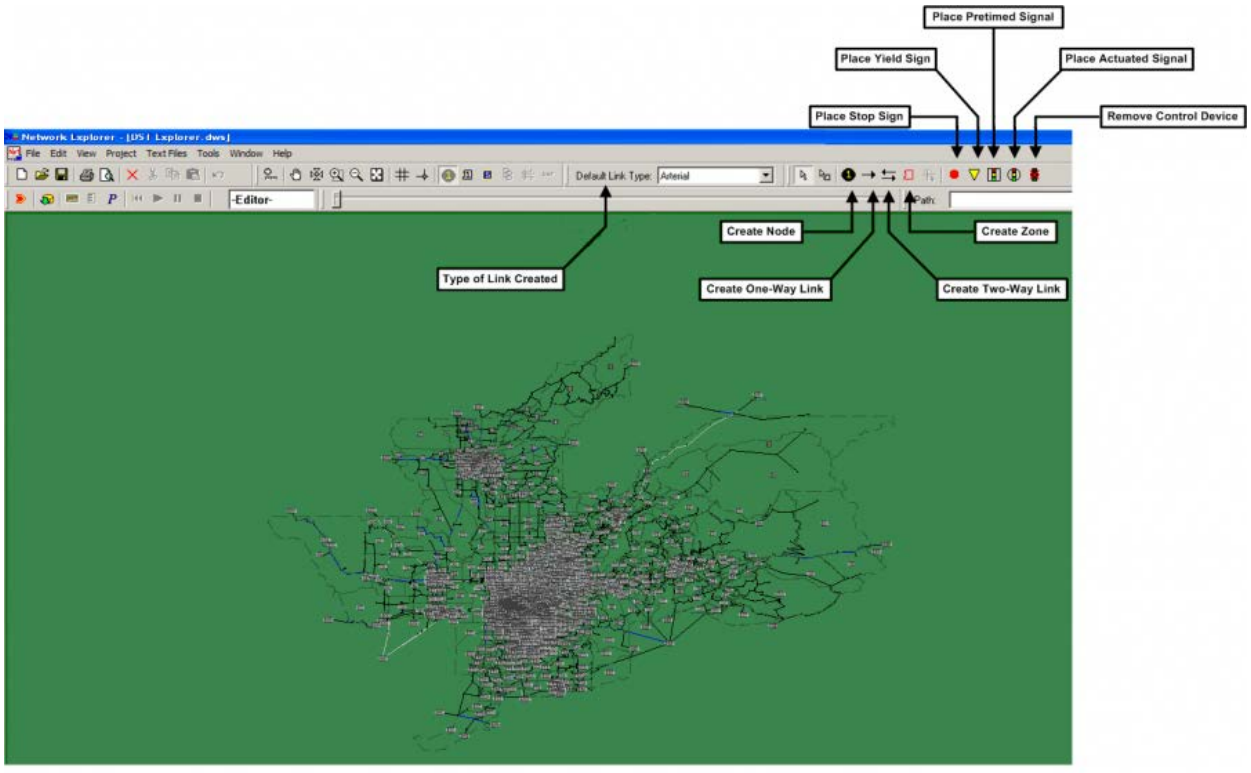


Figure 46: Creating New Nodes, Links, and Zones in NEXTA

(Source: http://dynust.net/wikibin/doku.php?id=start:getting_started#network_basics)

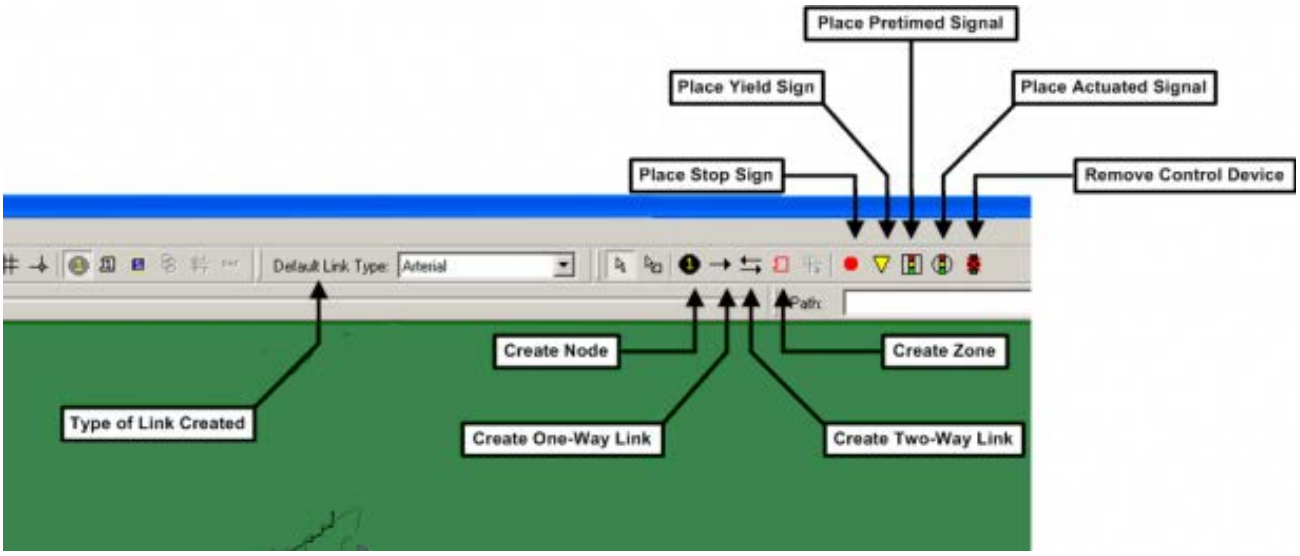


Figure 46a: Creating New Nodes, Links, and Zones in NEXTA- Zoom In

It is best to save the NEXTA project before engaging in network creation and editing. The user must save the network in the location of the WISE Workspace. The specific location to save the network is located in *"*WISE Workspace folder*\Planning*," where *WISE Workspace folder* is the location and folder name of the WISE Workspace. Saving in this location is very important; if not saved in the correct folder, WISE will throw an error, as shown in Figure 47.

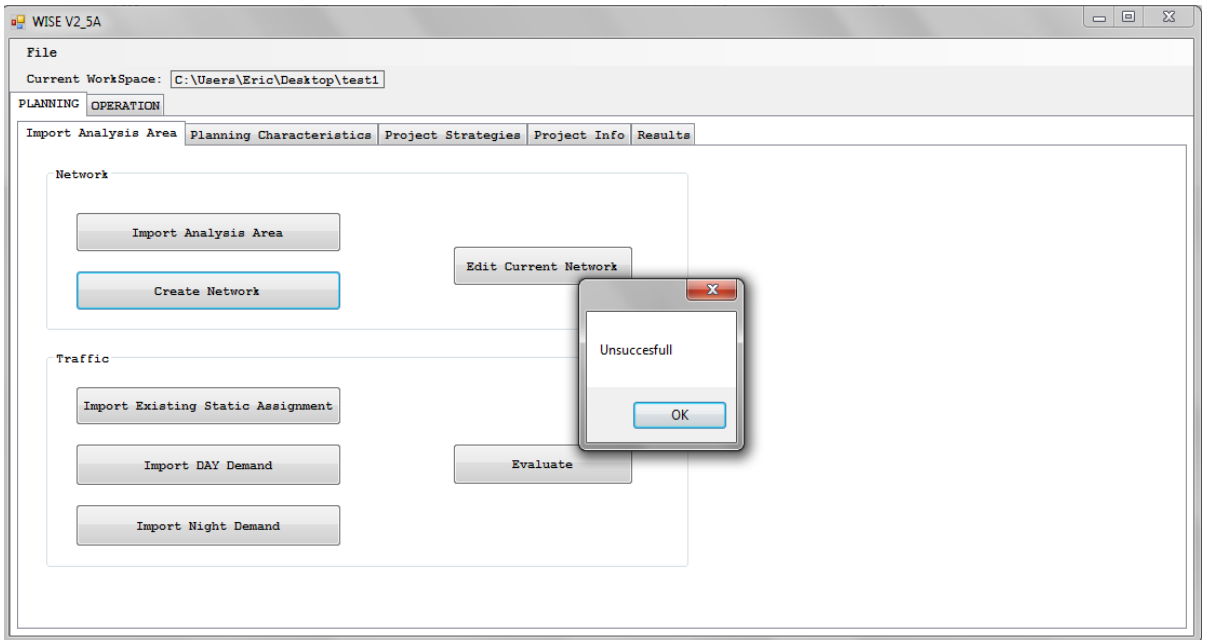


Figure 47: WISE Error Creating Network from Scratch

Once the user has created the desired network, the user can then close the NEXTA window, and the network will be recognized by WISE. To ensure that the network is correctly saved and recognized by WISE, click on the "Edit Current Network" button, as shown in Figure 48.

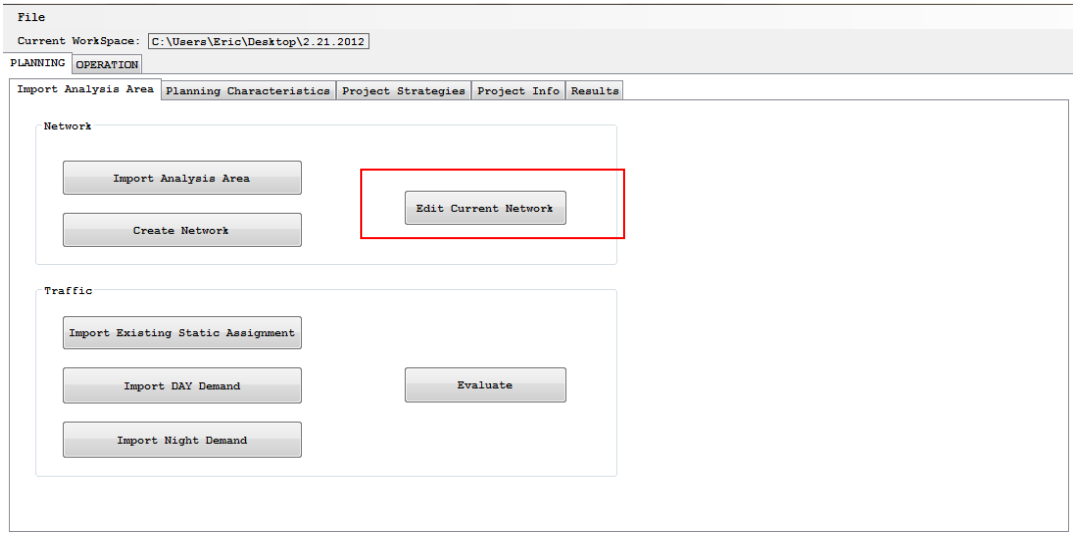


Figure 48: Edit Current Network Button in WISE

Importing Traffic Information

The WISE Planning Module is capable of using existing traffic information if such information is available from an external source or separate traffic study. For example, users have an option to perform traffic assignment analysis through an external traffic software/package, e.g., TransCAD or CUBE, and then import the assignment results as existing traffic information into WISE. The information that is used by WISE is the link travel time and link flows from assignment.

WISE supports importing traffic information for up to two different time periods, to recognize demand variance during the time of day. By default WISE recognizes one peak demand as "day demand" and the other non-peak demand as "night demand" (Figure 49). It is the modeler's option to import two demand periods that s/he is interested in analyzing delay for either day or night or both, and the user has the option to define how many hours the two respective demand periods represent. WISE analyzes hourly traffic delay caused by the representative demand and then multiplies by the number of hours to obtain the daily traffic delay, i.e., user cost, that will be utilized in the sequencing algorithm. For example, if a modeler anticipates that major traffic delay in daytime will occur in the morning peak from 6:00-9:00 a.m., then s/he can import a demand averaged from 6:00-9:00 a.m. as a day demand and define the number of hours associated with this demand as three hours. WISE analyzes hourly delay and then multiplies by three to obtain daytime delay resulting from the representative demand.

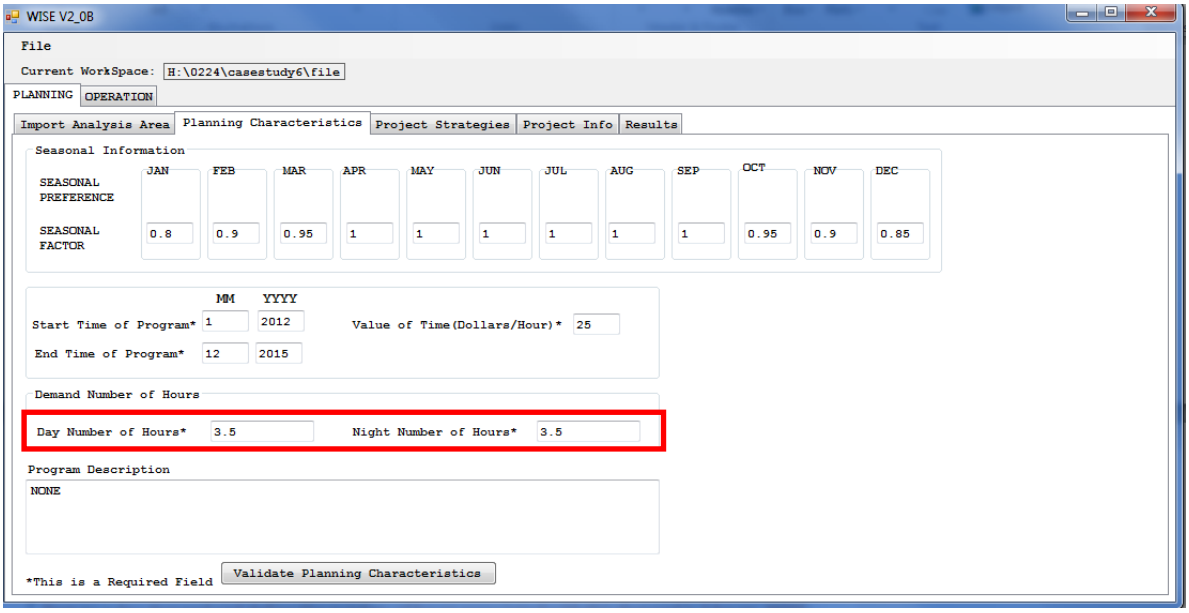


Figure 49 Define Number of Hours of Representative Demand

If the user opts to import existing traffic information, follow the steps below.

Input file preparation

A file titled "STATIC_IMPORT.csv" is a comma-delimited file (*.csv) and will need to be prepared for the WISE software to import. The file contains the following columns, and Figure 50 shows the format that is required to populate this information.

- FROM_ID
- TO_ID
- DAY_TIME
- NIGHT_TIME
- DAY_FLOW
- NIGHT_FLOW

	A	B	C	D	E	F	G	H
1	FROM_ID	TO_ID	DAY_TIME	NIGHT_TIME	DAY_FLOW	NIGHT_FLOW		
2	540	550	0.18	0.08	4557.5	742.36		
3	550	542	1.71	0.77	4461.5	735.09		
4	502	503	0.04	0.02	4024.5	658.82		
5	503	540	0.17	0.09	4024	658.82		
6	501	502	1.15	0.64	4021.5	604.46		
7	919	546	0.51	0.3	3893.5	811.91		
8	546	983	0.18	0.17	3570.5	780.27		
9	983	994	0.1	0.1	3569	780.27		
10	994	504	0.54	0.36	3563.5	780.09		
11	531	501	0.65	0.44	3534.5	245.55		
12	693	692	0.05	0.04	3415.5	1227.64		

STATIC_IMPORT

Figure 50: STATIC_IMPORT.csv file Opened in Excel

The FROM_ID and TO_ID are the start and end node IDs of all existing links in the network. Every link must be represented in this file. The DAY_TIME and NIGHT_TIME columns refer to the link travel time in minutes. The DAY_FLOW and NIGHT_FLOW columns refer to the assigned flow rate in vehicles per hour (vph). If the WISE tool is only being used for either daytime or nighttime, for whichever time period is not being used, place "0" is the appropriate fields.

Importing OD trip demand

Importing OD trip demand refers to importing OD trip tables that represent the daytime period and nighttime period being modeled in WISE. The demand information being imported should correspond to the zonal count of the imported network.

The demand serves as the input for the static assignment if the user is running the static assignment function in WISE, i.e., "Import Existing Static Assignment" is not being used.

OD trip demand file preparation

The general procedure to prepare the OD trip tables in the format WISE requires for conversion is as follows.

1. Export from the planning software the demand (OD) data to a comma delimited (.csv) text file, as shown in Figure 51.
2. Save the file as a *.txt file. For daytime demand save the file as "day.txt." For nighttime demand save the file as "night.txt."

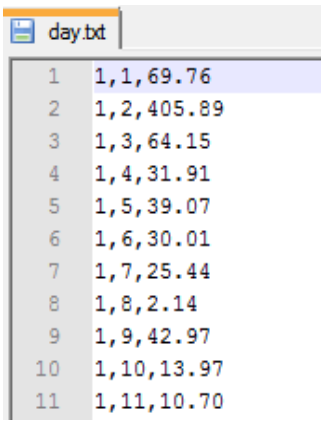


Figure 51: Three-Column Format of OD Trip Table

Importing

Once the demand text files have been prepared, click the Import DAY Demand (or Import NIGHT Demand), as shown in Figure 52, and a file browser will open. Choose the location of the day.txt file, as shown in Figure 53. The function will then convert the demand information to the appropriate format required for the WISE software.

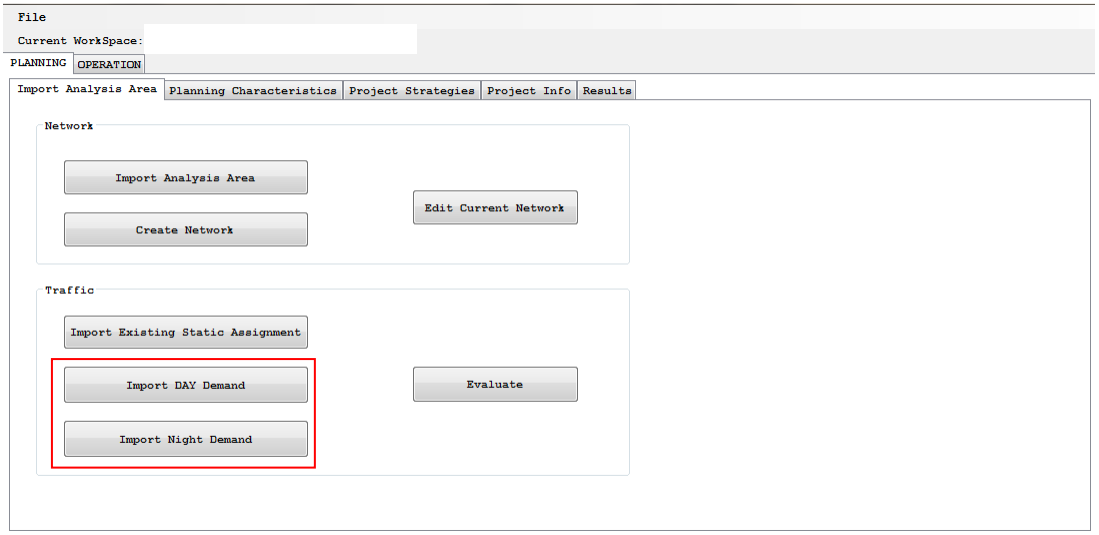


Figure 52: Import Demand Data

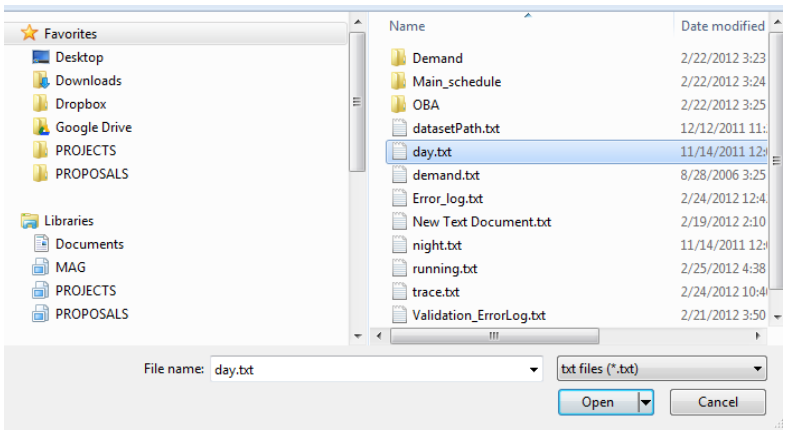


Figure 53: Selecting the Demand Text File

III. Operations Module

Hand-off Between Planning and Operations (Interconnection)

DynusT

DynusT is a dynamic traffic simulation and assignment (DTA) software that can support engineers and planners in addressing emerging transportation planning and operations issues. With DynusT engineers and planners can estimate the evolution of system-wide traffic flow dynamics patterns resulting from individual drivers seeking the best routes to their destinations responding to changing network demand, supply, or control conditions.

DynusT was not developed to replace travel demand models or microscopic simulation approaches; instead, by integrating with travel demand models and microscopic simulation models, it is aimed at supporting application areas in which realistic traffic dynamic representation is needed for a large-scale regional or corridor network. These application areas include assessing the impacts of alternate traffic operations and control strategies and evaluating strategies for work zone, incident, and special event management. Engineers or planners can also use the software to assess the impacts of intelligent transportation system technologies, such as dynamic message signs, ramp meters, and in-vehicle guidance systems, on the transportation network. In addition, DynusT can evaluate congestion-pricing schemes for toll roads and produce traffic operations data for air quality analyses.

DynusT consists of iterative interactions between its two main modules: traffic simulation and traffic assignment. Vehicles are created and loaded into the network based on their respective origins and follow a specific route based on their intended destinations. The large-scale simulation of network-wide traffic is accomplished through the mesoscopic simulation approach that omits inter-vehicle car-following details while maintaining realistic macroscopic traffic properties, i.e. speed, density, and flow. After simulation, necessary measures of effectiveness (MoEs) are fed into the traffic assignment module. The traffic assignment module consists of two algorithmic components: a time-dependent shortest-path (TDSP) algorithm and time-dependent traffic assignment. The TDSP algorithm determines the time-dependent shortest path for each departure time, and the traffic assignment component assigns a portion of the vehicles departing at the same time between the same OD pair to the time-dependent least-travel time path following the “route swapping” type of traffic assignment procedure.

DynusT in WISE

DynusT is the main functionality behind the Operations Module. The concept behind the Operations Module is to dive deeper into the time-varying interactions occurring between traffic and the network during a work-zone project. What a static model cannot capture — time-dependent congestion and diversion caused by congestion — a simulation model such as DynusT can. DynusT can still use the macroscopic network yet provide in-depth information of a microscopic simulation model.

The Operations Module requires the sensitivity of a simulation model that responds to congestion so that diversion response is reported in a robust and intuitive manner. The Operations Module attains a more accurate estimation of diversion due to the capacity reduction, i.e., work zone project, based on the network and simulation outcome. In WISE this diversion is reported back to the WISE system, and the user can choose whether to use this estimated diversion rate, i.e., feedback, in the Planning Module. Based on this new diversion rate, the user can model whether this diversion changes the sequencing of projects.

Dynamic Traffic Assignment

Dynamic Traffic Assignment (DTA) models have become a viable modeling option. DTA models supplement existing travel forecasting models and microscopic traffic simulation models. Travel forecasting models represent the static regional travel analysis capability, whereas microscopic traffic simulation models are superior for dynamic corridor level travel analysis. DTA models fill in the gap by enabling dynamic traffic to be modeled at a range of scales from the corridor level to the regional with expanded and unique functional capabilities enabled by the DTA methodology.

The objective of static traffic assignment is to determine network traffic flows and conditions resulting from demand/supply interactions via route choices from travelers. Route choice behavior is based on the assumption that all travelers intend to travel from their origin to their destination in the shortest time. When every traveler succeeds in finding such a route, every used route has the minimum time or cost between its origin and destination; moreover, for each OD pair, every route used has the same travel time. This condition is known as user optimal or user equilibrium. DTA has a similar objective but with a representation of time variations in traffic flows and conditions, thus attempting to reflect the reality of traffic networks.

Dynamic network analysis models seek to provide another, more detailed means to represent the interaction among travel choices, traffic flows, and time and cost measures in a temporally coherent manner, e.g., to improve further n the existing time-of-day static assignment approach. More specifically, DTA models aim to describe such time-varying network and demand interaction using a behaviorally sound approach. The DTA model analysis results can be used to evaluate many more meaningful measures related to individual travel time and cost as well as system-wide network measures for regional planning purposes.

To learn more about DTA, read the DTA primer from the TRB website at http://www.trb.org/DataInformationTechnology/Blurbs/165620.aspx. (Chiu, Bottom, Mahut, Paz, Balakrishna, Waller and Hicks, 2011).

Running a WISE Project in Operations (DynusT)

Importing Time-Dependent Demand

Because the Operations Module is aimed at examining the time-varying congestion interactions, the modeler has the option to input time-dependent demand to represent changes in service demand over time, especially for the peak periods of congestion. DynusT uses OD trip demand as the input for

vehicle generation for simulation. With NEXTA the modeler can create time-dependent demand for a peak period of interest.

Please note that the demand being imported is a single demand matrix being divided into several demand periods.

The general procedure for time-dependent demand conversion is as follows.

1. Export from the planning software the demand (OD) data to a comma delimited (.csv) text file.
2. Go to the installation directory of DynusT. The typical path to this folder is *C:\Program Files \DynusT 3.1 (32 bit)*.
3. Copy the file demand.txt to another working location. This is the file that will be edited and imported to create the demand for DynusT.
4. Open the demand.txt file. It should look similar to Figure 53.
5. Replace the information in this text file. The fields are explained in the following steps. An example is given after the completion of general procedure.
    a. Line 3: number of zones in the network
    b. Line 6: number of demand periods that will be created from this import file
    c. Line 8: the uniform time duration of the demand periods being imported
    d. Line 10: the percentage of demand to each demand period from the single demand table being imported
6. Copy the exported demand data from step 1 and paste the data starting at line 12.
7. Save the demand.txt file
8. Open NEXTA and open the existing network project to which the demand will be imported.
9. In NEXTA go to *File → Import Files → Import GIS Data Set → Import Demand Table*, as shown in Figure 52.

demand.txt

```
1   //# of OD demand zones
2
3   2000
4
5   //# of demand intervals
6   4
7   // length of demand interval
8   60
9
10  0.24 0.30 0.27 0.19
11
12  1,1,46.3333
13  1,2,0
14  1,3,2.1667
15  1,4,43.5
16  1,5,48.6667
17  1,6,3.75
18  1,7,10.6667
19  1,8,52.9167
20  1,9,0.1667
21  1,10,5.75
22  1,11,6.4167
23  1,12,5.3333
24  1,13,5.6667
25  1,14,7.5833
26  1,15,37.5833
27  1,16,29.5833
```

Figure 54: Text File of Importing Time-Dependent Demand

Figure 54 explains the fields more completely. The “2000” indicates the number of zones in the network. Please change this to the correct number of zones of the WISE network. The “4” indicates the number of demand matrices that this importing demand data is going to represent, e.g., if a demand matrix from the planning tool represents a 24-hour time period and this table is being divided 24 times, there will be 24 demand intervals. The “60” represents the length of time (in minutes) that each demand interval represents. Line 10 gives the percentage of demand that each demand interval will have from the total demand data. For example, the first OD pair is from zone 1 to zone 1, and the demand for this pair over the four hours (four demand intervals at 60 minutes each interval) is 46.3333. The demand for each one-hour interval will then be 11.12, 13.90, 12.1, and 8.80, based on the proportions given in line 10.

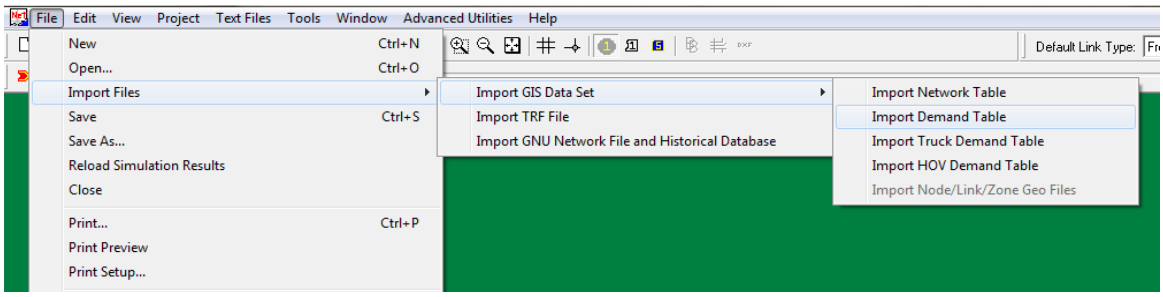


Figure 55: Importing Time-Dependent Demand Text File

Operations Traffic Diversion

The Operation Module can only be utilized once the Planning Module has been set up with Projects and a valid network. The Operation Module is used to calculate a diversion for each Project to be utilized in the Planning Module WISE Analysis Engine as specified in the Project Information for each project. Once the Planning WorkSpace is set up, the Operation Tab will be populated with a list of all Projects in the WorkSpace (Figure 56). The user must run a base scenario for all Projects and an individual Project Scenario for each Project for which the user would like Operation Module to provide Diversion calculations.

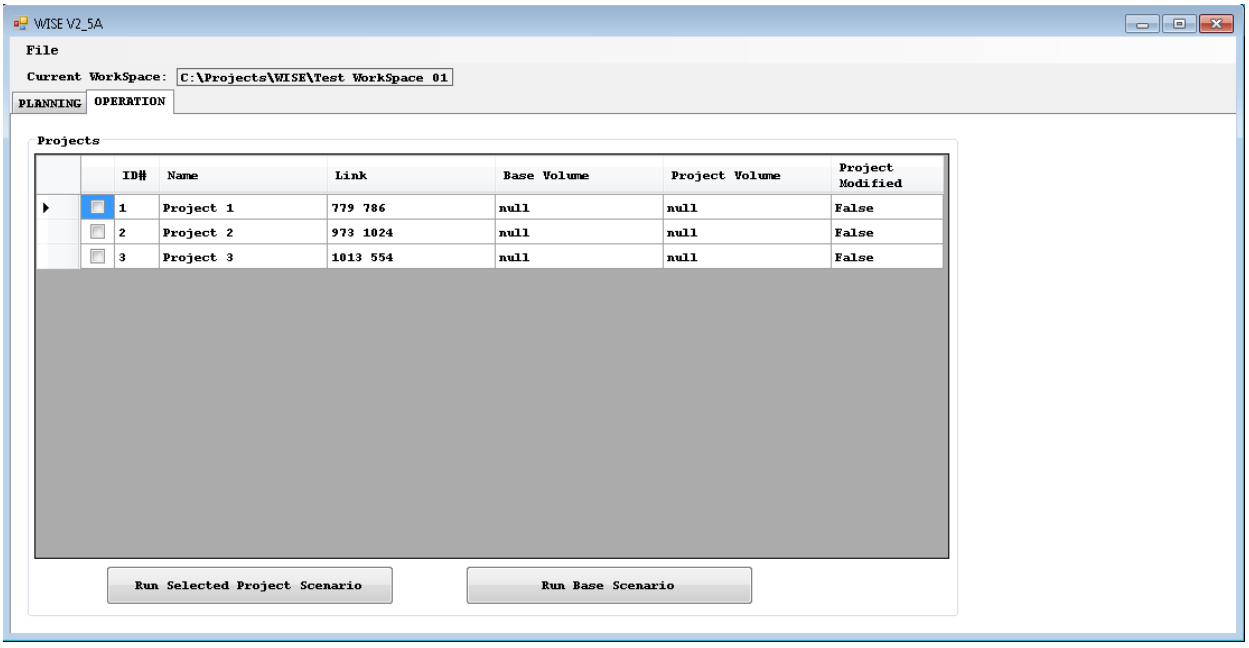

WISE V2_5A
File
Current WorkSpace: C:\Projects\WISE\Test WorkSpace 01
PLANNING
OPERATION
Projects
ID# Name Link Base Volume Project Volume Project Modified
1 Project 1 779 786 null null False
2 Project 2 973 1024 null null False
3 Project 3 1013 554 null null False
Run Selected Project Scenario
Run Base Scenario

Figure 56: Need Caption

Base Scenario

To run the base scenario for all projects, the user must select ***Operation Tab -> Run Base Scenario*** seen in Figure 57. The Operation Module will perform a validation of the Planning Module and only run if the WorkSpace passes Planning WorkSpace Validation. If the Planning WorkSpace Validation is clear, the WISE GUI will launch NEXTA for the base scenario. The user must then launch DynusT to perform an analysis (see Section 2.5 of DynusT instructions, also Section X,

Resources and Useful Links). Once DynusT has completed the analysis of the base scenario, close NEXTA/DynusT, and if the analysis was successful, the WISE Operation Tab will now populate the Base Volume column with the Base Volume from the DynusT analysis for each Project, as seen in Figure 57. WISE will display an error if the DynusT run was unsuccessful.

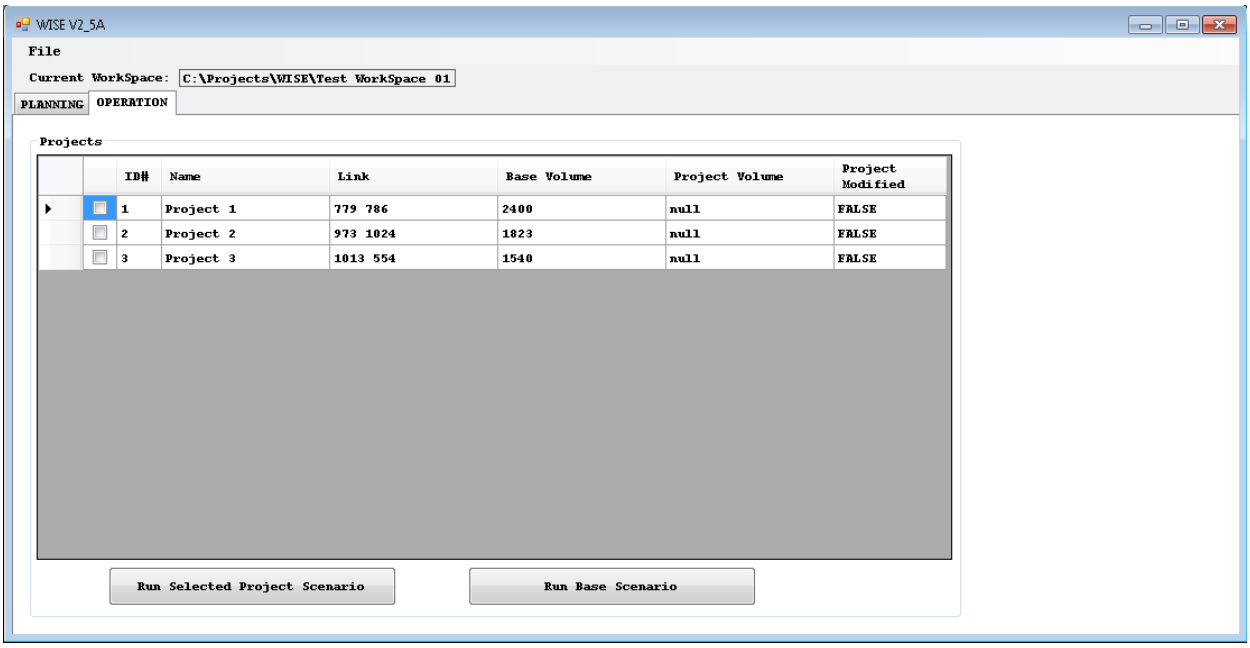


Figure 57: Operation Module: Project Volume Population

Individual Scenario

To run the individual scenario for a project, the user must select the checkbox next to the Project for which they would like to run the Scenario on the Operation Tab Projects list and then select ***Run Base Scenario***, as seen in Figure 58.

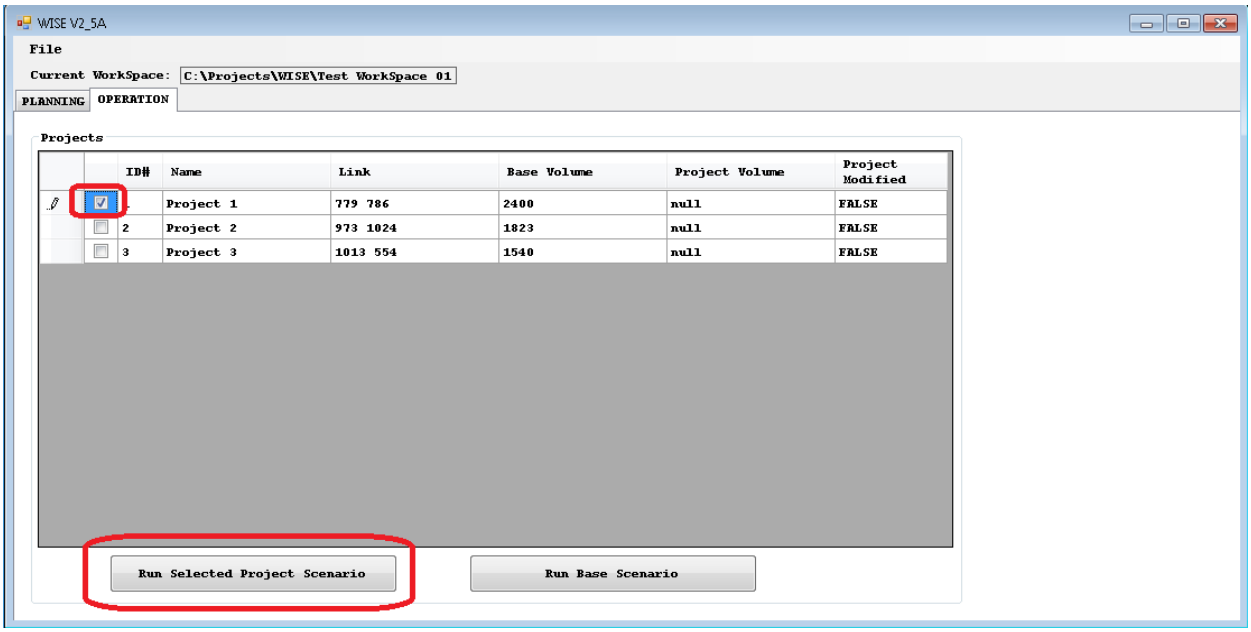


Figure 58: Operations Module: Running Scenarios

The Operation Module will perform a validation of the Planning Module and only run if the WorkSpace passes Planning WorkSpace Validation. If the Planning WorkSpace Validation is clear, the WISE GUI will launch NEXTA for the specific Project Scenario. The user must then launch DynusT to perform an analysis (see Section 2.5 of the DynusT instructions). Once DynusT has completed the analysis of the project scenario, close NEXTA/DynusT, and if the analysis was successful, the WISE Operation Tab will now populate the select Projects Project Volume column with the Volume from the DynusT analysis of the specific project scenario, as seen for Project 1 in Figure 59. WISE will display an error if the DynusT run was unsuccessful. (Note: WISE does not provide information on why a DynusT run might be unsuccessful. DynusT is supported by the University of Arizona and as such users should contact the U of A for support.

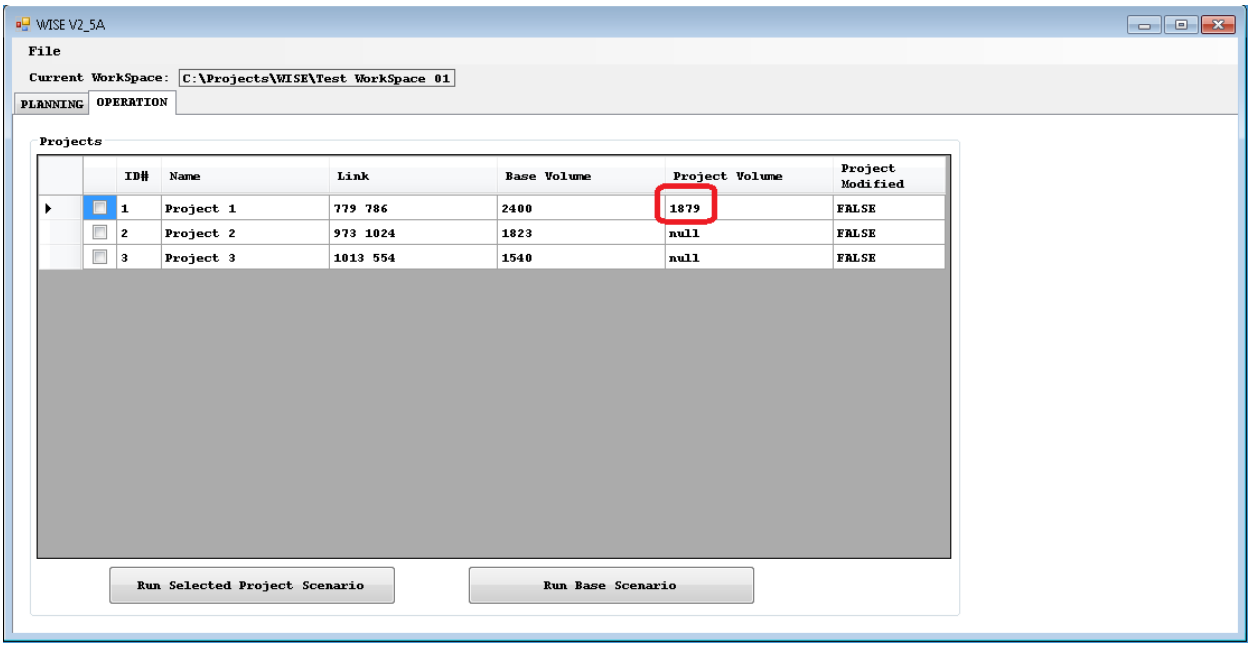


Figure 59: Operations Module: Project Volumes from DynusT

Modifications to Projects after Operation Scenario Runs

In the event that a Project is modified within the Planning Module, the Project and Base Scenarios may need to be run again to collect the correct volumes for the new Project scenario. A user can identify if a Project has been modified since the Base and Project volumes have been collected by viewing the Project Modified column on the Operation Tabs listing of Projects. If the Project Modified column is *False*, that means that no changes have been made to the Project or any attributes associated with it since the volumes were collected. If the Project Modified Column is ***True***, as seen in Figure 60 for Project 1, the project or attributes associated with it have been modified since the volumes were collected, and the user may want to re-run Base and/or Project Scenarios.

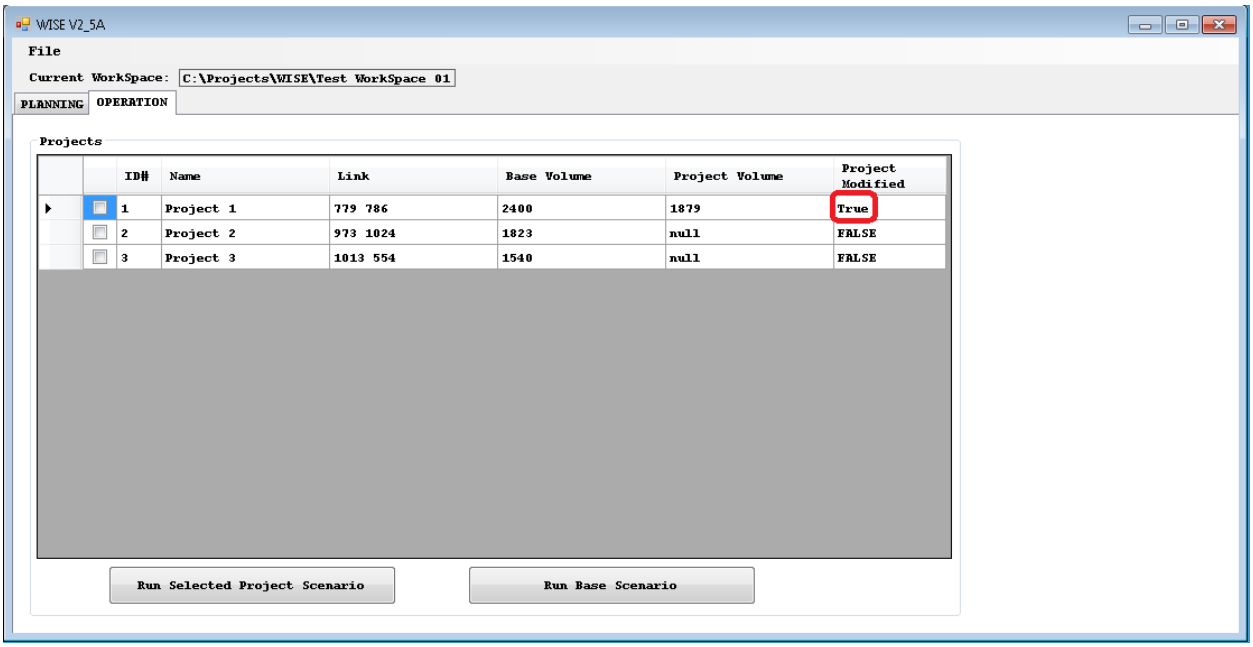


Figure 60: Operations Module: Internal Checks

IV. Back to Planning

Planning and Operation Hand-Off

Once a given Project has collected the data for the Base and Project Scenario, this Project can now use the Operation-Supplied diversion within its Project Information in the Planning Module (see Creating Projects in Section IV). The user can now go back to modify the Project and select Operation-Supplied Diversion. **Note:** The Operation-Supplied Diversion is **ONLY** available if the Operation Module produced a valid Diversion (see Section IX, Data Limits, for details on valid values for Diversion). Otherwise the Operation-Supplied Diversion will remain "null" in the Project information Tab. Once the Operation Module has a valid diversion, the user may choose to go back to the Planning WISE Analysis Engine and rerun the analysis with the new diversion.

V. Acronyms and Glossary

Classification of Software Functionalities

Transportation Modeling Categories.

Analytical/Deterministic. Analytical and deterministic tools are usually based on the procedures found in the Highway Capacity Manual. The resulting factors (capacity, density, LOS, delay, queue) from these tools are based on empirical equations derived from field data and small-scale experiments. This type of tool is able to analyze small-scale effects but is not practical for large-scale, network applications.

DynusT: A dynamic traffic assignment simulation model released under a GNU General Public License (GNU General Public License**:** A free software license—DTALite and DynusT were released under this license for use in projects C05 and C10B) as a precondition for award of Project C10B (Partnership to Develop an Integrated Advanced Travel Demand Model with Mode Choice Capability and Fine-Grained, Time-Sensitive Networks). A dynamic traffic assignment model is a computerized analysis package that tracks the movements of individual vehicles in a model street network and quantifies the performance of the network by summing the results of individual vehicle movements. DynusT is being enhanced and mated with SacSim (SacSim: An activity-based traffic model released in an open-source format by the Sacramento Area Council of Governments. This model will be enhanced and mated with DynusT in Project C10B (Partnership to Develop an Integrated Advanced Travel Demand Model with Mode Choice Capability and Fine-Grained, Time-Sensitive Networks) under SHRP2 project C10B. DynusT is also the platform for the operations module of WISE.

GUI: Graphical User Interface

Simulation – Macroscopic. Macroscopic simulation models use the fundamental traffic qualities of speed, volume, and density on a sectional basis (i.e. network links). This means that tracking individual cars in a macroscopic model is impossible. They require less detailed network link data to operate than microscopic models, but do not offer as much detail.

Simulation – Mesoscopic. Mesoscopic simulation models provide middle ground between the macro- and micro-scopic approaches. Mesoscopic models typically are able to track individual vehicles, but also rely on speed, volume, and density relationships to determine the movement of these vehicles.

Simulation – Microscopic. Microscopic simulation models are capable of tracking individual vehicles on a second-by-second basis and capture the ways that these vehicles interact with each other. This means that these models employ car-following and lane-changing algorithms to determine individual vehicle behaviors.

Tool Suite. A "tool suite" is a computer software package that combines two or three of the simulation types described above. In this way, a user is able to easily model a network with different fidelities when necessary. Examples include VISSIM with VISUM and TransCAD with TransModeler.

Traffic Signal Optimization. Traffic signal optimization software packages are tools used to develop signal timing plans at both isolated locations and synchronized corridors or grids. These tools also require basic information such as traffic counts for intersections.

Travel Demand Model. Travel demand models are mathematical models that are used to determine the travel patterns based on demand. Originally, these types of models were developed to determine the impact of infrastructure improvements. They forecast specific outputs, such as mode choice, destination choice, and route choice.

Geographic Scale

The geographic scale of a work zone becomes important when attempting to model potential traffic impacts. A variety of software packages exist across a broad spectrum for modeling different sizes of networks. Software on the lower end of the spectrum, such as Highway Capacity Software (HCS), describes traffic with simple in/out patterns and is a good match for isolated work zones. Other types of software that are capable of modeling entire regional road systems would be a good fit for network (grid) and regional work zones where detours may need to be analyzed.

The geographic scale of a work zone is a consideration of both the size and impact of any potential road work. The main types of work zone geographic scales fall into four main categories: isolated, corridor (pipe), network (grid), and regional.

Corridor (Pipe). A corridor work zone (or pipe work zone) is any road work that occurs along a major highway segment. An example of this type of work zone would be an interstate widening or repaving project. This type of work zone is slightly larger in size and has the potential to cause more traffic disruption on the regional level.

Isolated. An isolated work zone can be thought of as a single point within a much larger network. Examples of isolated work zones can include rural lane closures or redesigned intersections. This type of work zone is small in size and should have minimal impact on traffic over the regional network.

Network (Grid). A network work zone (or grid work zone) is any project that involves construction on connected, inter-dependent roads with multiple access points. This type of construction may also require one or more viable alternate routes. Examples include interstate reconstruction, full roadway closures, and works zones in urban centers. This type of work zone is large in size and will disrupt traffic patterns on a large scale. However, the impact is usually restricted to an urban area.

Regional. A regional work zone is similar to a network work zone in that it involves construction taking place on connected and inter-dependent routes and may require detours. The difference between the two is the size of the traffic impacts. Regional work zones will cause regional level traffic impacts. This could possibly mean disrupting several urban areas or several towns in a region.

Functionality

Software tools are utilized to make decisions regarding planning, operations, construction management, and logistics. Based on each field's purpose, the functionality ranges from cost/benefit analysis to traffic impacts and delay to efficient material transport and management.

Construction Management. Construction management involves the overall planning, co-ordination, determination of resource requirements and the implementation of the project. Determination of time-of-day for construction, project design and optimal construction scheduling, and traffic impact analysis are considered as part of the analysis to the estimate impact of management strategies.

Logistics. Logistics involves determining efficient practices to transport materials and optimal scheduling to reduce operational and storage costs. The workzone logistics would involve the duration of the closure of lanes, determining construction techniques and how the workers will put up the cones, etc.

Operations. Operations involve analysis of current management and safety of traffic and other users. Operations typically involve planning and maintaining signs, signals, pavement markings and lighting. The management of intelligent transportation systems and safety initiatives to improve driver behavior are considered. Determination of traffic measurements such as delay, speed, occupancy, levels of service, queue lengths, and others are used to evaluate the behavior and functionality of traffic operations and management.

Planning. Planning involves making long-term decisions and goals. The involvement of all users of the system is normally considered as part of the process as improvement strategies are evaluated to improve the overall functionality of the system. Forecasting future demand growth, employment, and land use are normally considered, as well as estimating impacts of proposed future improvements.

Users and Proprietary Issues

Users such as engineers and transportation planners are intended to incorporate software packages that were evaluated for various functionalities identified in the previous section.

Engineers. Use by engineers typically involves studying traffic impacts from an operational aspect as well as the planning process of project-specific construction and operational management strategies. Project design and coordination are topics considered with the engineers interested in actual implementation of such strategies.

Planners. Use by planners typically involves the advanced long-term planning of strategies for a road network depicting various projects to improve system-wide functionality. Demand forecasting, employment, and land use strategies are topics of interest for such planners, as well as system effects and air quality issues based on traffic and population growth.

Proprietary. Proprietary software is defined as software that is licensed under exclusive legal right of the developer and/or owner. The user is given the right to use the software under license agreements and is restricted from tampering with and modifying such software.

Other software may be termed as open source or freeware, meaning the use and licensing is more liberal in use of, the study of, and changes and improvements of software made by users. Freeware focuses more on the free use of software, and open source is focused on the community use and development of software to benefit the overall software community.

Data Inputs

Cost of Various Strategies. Different construction strategies have different implications on life cycle costs. Use of fast construction material and techniques can result in reduction in the period of time workzones are implemented but may require higher regular maintenance costs during the life cycle of the project. These costs and benefits need to be evaluated at a life cycle level.

Pavement. As identified in the interviews in Phase I most DOTs and MPOs pavement management systems play a critical role in determining projects and project sequencing. Therefore it is critical to determine software tools that need pavement inputs and how they are utilized.

Production Rate for Various Strategies. Several construction strategies identified during the interviews have different production rates depending on the materials being used, the construction technique, weather and night vs day. This would have a significant effect on the duration of work zone.

Traffic. Traffic data includes volume counts, speeds, travel time and density and are used to calibrate and validate simulation models.

Measures of Effectiveness

Agency Cost. A figurative cost (typically construction related cost) to a government agency (usually the Transportation Department) faced by delay in construction and construction costs.

Environmental Impact. The environmental impact is directly related to the amount of emissions vehicles make during their trips. This measure is especially relevant when there is a large amount of congestion present.

Road User Cost. A figurative cost ascribed to all road users who face delay and congestion. This cost represents the negative impact of such road conditions and the road user's preference to avoid such costs.

Safety Surrogates. Any data set that can act as a surrogate to safety. For example, speed variance, number of lane changes and conflicting points.

Traffic Conditions. Traffic conditions represent a broad data set used by traffic engineers and planners to assess the traffic conditions (such as speed, delays, accelerations, lane changing etc.) on any particular roadway.

Queue Length and Delay. Queue lengths and delays are used as a measure of effectiveness to evaluate the type and level of impact a work zone shall have.

Resource Requirements

Animation/ Presentation. The ability of the software to make animations or presentations. This is very important for traffic simulation, not only to present results but also in order to locate trouble spots in the network.

Availability of Source Code/ Algorithm. "Open-source" software is any computer program that allows fellow developers to see the actual code that makes up the software. This makes it much easier for developers in similar areas to calibrate. Open-source software is usually free or donation-based.

Computational Speed. The computational speed of software is a measure of the amount of time it takes execute all the required steps from start to finish. Most can be done in a matter of minutes, but more complicated systems can take several hours.

Cost. The cost of software is the price that the developer and/or publish asks the user to pay for their product. This is the opposite of non-proprietary software, which is available for free or by donation.

Effort in Application. The amount of effort required in transferring an existing network or data set into the newer system.

Excel Based. Excel-based software uses Microsoft Excel as a 'window' into which the software is entered. This means that the software is merely an extension of Excel rather than unique software.

Level of Effort for Training. A measure of a software's ease of use. Easy software can be understood after only a few demonstrations, but more complicated software may require several days of training. As a general rule, open-source software is usually more complex and less user-friendly than commercially developed software.

Memory. The amount of memory a given program will take up is a measure of the size (in bytes) of the program and its files.

Transferability of Data to Other packages. The ability of data to be exchanged across multiple packages is important in order to coordinate output between packages. This is usually facilitated by either file conversion or relying on a universal file format.

Dynamic Demand Changes

Departure Time Choice. Departure time choice is usually a facet of the mode choice a traveler must make. For instance, a traveler using a passenger car may depart at any time, while a traveler using bus transit must wait until the next bus arrives in order to depart.

Destination Change. A destination change occurs when a traveler diverts to a destination other than the one they originally intended when the trip began.

Enroute Route Diversion. A diversion that occurs when a traveler decides to alter his route during the trip. This could be due to a number of factors including: ITS signs warning of impending congestion, radio announcements, word-of-mouth, or approaching traffic congestion first-hand.

Induced/Foregone Demand. Induced demand (latent demand) is a phenomenon that occurs when traffic volumes increase when facility LOS and/or capacities increase. Foregone demand is the opposite effect, where facilities with low LOS and/or capacities experience lower volumes due to traveler's hesitancy to use such facilities.

Mode Shift. Any shift a traveler makes in mode in order to complete a trip. This action could be part of an overall trip plan or due to dissatisfaction with the current mode.

Pre-Trip Route Diversion. This type of diversion occurs when a traveler decides to alter his route before the trip begins.

VI. Data Limits

"Project Information" Constraints:

Field	GUI VALUE	Comment
Work zone speed	5 <= x <= the original speed limit; integer	The work zone speed limit cannot be zero or cannot be faster than original speed limit
User-supplied diversion rate	If user-defined diverge is TRUE, 1 <= x <= 100; integer. If user-defined diverge is FALSE, x=0	If the route diverge uses user defined rate, 1<=x<=100, integer. If the route diverge compute diverge rate internally, x=0
Day cost	integer and non-negative	
Night cost	integer and non-negative	Agency cost should be realistic
Capacity/Lane reduction	X >= 0.01; float	Percentage of capacity reduction due to work zone construction. Should be greater or equal to 0.01
Duration	Integer; 1 =< x <= (latest end time – earliest start time);	This must be careful with duration-based strategies
Duration-based strategy*	If one project i was applied by a duration based strategy k, the duration of project i >= duration based strategy+1	Duration based strategy cannot reduce the project duration to zero or negative.
Link	Single-use	Each project is unique link

"Strategy Information" Constraints:

Field	GUI VALUE	Comment
Demand-reduction rate	1 =< x =< 5; integer	Demand-based strategy cannot reduce demand more than 5%
Demand-based radius	1 =< x =< 5; integer	Demand-based strategy is only effective to reduce demand within a radius of 1 and 5 miles around the construction link
Demand-based cost	integer, non-negative	Agency cost
Duration reduction*	integer x>=1	
Duration-based cost	integer, non-negative	Agency cost

*Same value; boundary rule defined in "Project Information" Constraints will be applied to each project specifically.

"Planning Characteristics" Constraints:

Field	GUI VALUE	Comment
Value of time	$5 < x < $300; float	Between $5 - $300
Start time year	2010; integer	Cannot be less than the year 2010
End time year	2030; integer	Cannot exceed the year 2030
Day number of hours	1= < x <= 12; float	Between 1 and 12 hours of day
Night number of hours	1 =< x <= 12; float	Between 1 and 12 hours of night
Seasonal factors	0.5 =< x <= 1.5; float	Stay within reasonable range
Number of projects	1 = < x =< 20; integer	The engine cannot exceed more than 20 projects

If any errors related to these data limitation fields are made, the user will be prompted by the engine that an error has been made and that an error file called "error_log.txt" was produced.

VII. Annotated Bibliography

1. Cambridge Systematic, PB Consult and System Metrics Group, *Analytical Tools for Asset Management*, NCHRP 545, 2005
   Provides a VERY useful framework for evaluating trade-offs in decision making processes in transportation program development. We believe that evaluation of trade-offs is critical to selection and weighting of performance measures. This is the foundation of development of scenario analysis/comparison models.

2. Cambridge Systematic, *Tools Summary Sheet*, NCHRP 20-57, 2005.
   Summarizes capabilities and limitations of 11 modeling software packages, including HDM-4, HERS/ST, and STEAM, that evaluate econometric and other parameters. This assisted in the identification and evaluation of commercially available software products called for under Task 5 of this project.

3. Dr. Stuart Anderson, *Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming and Preconstruction*, NCHRP 574, 2007.
   This report will be very helpful in building scenario analysis capabilities for the software product in Phase II of this project. Analyzing complex variables of material costs, labor costs, and right-of-way costs with imprecise or incomplete information at the planning and program management stages is inherently difficult and uncertain. This very capability is what will be developed for the software for this project.

4. DynusT Wiki Online Help, 'Generation Links and Destination Nodes', Getting Started, DynusT© Online User's Manual, June 2011

5. DynusT Wiki Online Help, 'Generation Links and Destination Nodes: Default Control Signals', Getting Started, DynusT© Online User's Manual, June 2011

6. DynusT Wiki Online Help, 'Getting Started', DynusT© Online User's Manual, June 2011

7. J. Hugh Louch, *SHRP 2 CO2 - A Systems-Based Performance Measurement Framework for Highway Capacity Decision Making,* Cambridge Systematics, 2009.
   This related SHRP II project provides a decision-making framework with regard to performance measures that will help formulate the topology of performance measures as well as guidance in the selection of performance measures for this project.

8. Panagiotis Anastasopoulos, Samuel Labi, Bob McCullouch, *Identifying the Appropriate Contract Types for Highway Maintenance and Rehabilitation Projects on the Basis of Project Characteristics*, Transportation Research Board Annual Meeting, Paper #09-2203, 2009.
   Traditional vs. innovative contracts are analyzed in this report using simultaneous equation models. We believe that this work will provide useful insights into cost/benefit decision making with regard to innovative contracting. Use of calendar completion vs. working day completion

contracts as well as incentive/disincentive clauses in contracts shifts some of the risk of late completion onto the contractor, but agencies may pay a significant premium for such a shift. We believe that a technique to evaluate the cost/benefit of such contracting options will be important to the tools developed under this Project.

9. Stuart D. Anderson and Ivan Damnjanvoic *Selection and Evaluation of Alternative Contracting Methods to Accelerate Project Completion,* TRB's National Cooperative Highway Research Program (NCHRP) Synthesis 379, 2009
   This report presents a methodology for identifying, evaluating, and selecting alternative contracting procedures. The strategy of minimizing time-to-delivery is specifically identified for this project. This work will assist in developing scenario indexing capabilities that are described in Section 3.0 of this report, to be developed in Phase II of this project.

10. Tom Maze and Jon Wiegand, *Lane Closure Policy Development, Enforcement, and Exceptions: A Survey of Seven State Transportation Agencies*, Center for Transportation Research and Education, 2007
    Provides a very useful summary of performance measure selection by several state DOTs. This was useful in developing the performance measure topology, as part of the software tool for this project. It also helped identify interview candidates for Tasks 3 and 4.

11. Wenteng Ma, Ruey Long Cheu, M.ASCE; and Der-Horng Lee, M.ASCE, *Scheduling of Lane Closures Using Genetic Algorithms with Traffic Assignments and Distributed Simulations,* Journal of Transportation Engineering, Vol. 130, No. 3, June 2004, pp. 322-329.
    This report presents findings of scheduling of lane closures, particularly the redistribution of traffic across a network as a result of such closures. We believe that the genetic algorithms presented will provide useful insights into sequencing multiple lane closures so that traffic is not redistributed onto already bottle-necked portions of the network.

12. Worldbank, *Road Software Tools (HDM-4*, Transport: Roads and Highways: Development Topics, World bank Website, 2002 *)*.
    Page 12 of this document contains a definition of Program Management that the Team believes could frame a great deal of the work on subsequent tasks. Table 4 presents useful guidance in "bright-lining" application of program management that we believe may assist in the decision-tree development for the tool developed in Phase II of this project.

    Table 4: Table pulled from Road Software Tools (HDM-4)

SCOPE OF ROAD MANAGEMENT FUNCTIONS				
Management function	Nature and scope of actions involved	Network coverage	Time horizon	Management staff concerned
Planning	• Defining road standards which optimize the use of resources • Determining the budget required to support defined standards	Entire network	Long term (strategic)	Senior managers and policy-makers
Programming	Determining the work program that can be undertaken within the budgetary period	Sections likely to need treatment	Medium term (tactical)	Managers and budget holders
Preparation	• Design of works • Preparation and issue of contract or work instruction	Contract or work packages	Budget year	Engineers, technical and contracts staff
Operations	Undertaking tasks as part of works activity	Sub-sections where works are taking place	On-going	Works supervisors

13. Yi-Chang Chiu, Jon Bottom, Michael Mahut, Alex Paz, Ramachandran Balakrishna, Travis Waller and Jim Hicks, 'Dynamic Traffic Assignment: A Primer', Transportation Research Circular E-C153, June 2011

14. Yimin Zhu, Irtishad Ahmad, *Developing a Realistic-Prototyping RUC Evaluation Tool for FDOT,* Florida Department of Transportation, 2008.
    This report outlines a software tool developed to calculate Road User Costs (RUCs) for various scenarios using readily available data. Estimating road user costs for adverse travel is an especially important element of this project, as are the scenario analysis capabilities presented in this report. This report will also likely tie into the evaluation of innovative contracting options discussed under A7 above.

Other Work Relevant to This Project

SHRP 2, Project CO1 and Project CO2. The SHRP 2 CO1 Project and CO 2 Project (A Framework for Collaborative Decision Making and Additions to Highway Capacity and; System-Based Performance Measurement Framework for Highway Capacity Decision Making) is developing and implementing web-based resource and highway decision making web-based tool. The results of R-11 and the subsequent tools for evaluating the impacts of renewal projects should be incorporated and integrated within web-based resources established for the CO1 and CO2 SHRP 2 projects.

FHWA Work Zone Mobility and Safety Program. A review of the materials created by the FHWA Work Zone Mobility and Safety Program was conducted specifically on the development of strategies and performance measures for work zones. Pertinent and important information identified by the FHWA Program include the areas of:

1. Performance Measurement Development

2. Work Zone Traffic Management Guidance and Examples – State-Developed Traffic Management Resources (New Jersey DOT, Ohio DOT, Oregon DOT, and PennDOT)

3. Peer-to-Peer Program for Work Zones

4. Work Zone Mobility and Safety Self-Assessments (includes an assessment by the State DOTs on the integration of work zone mobility and safety as part of the planning process).